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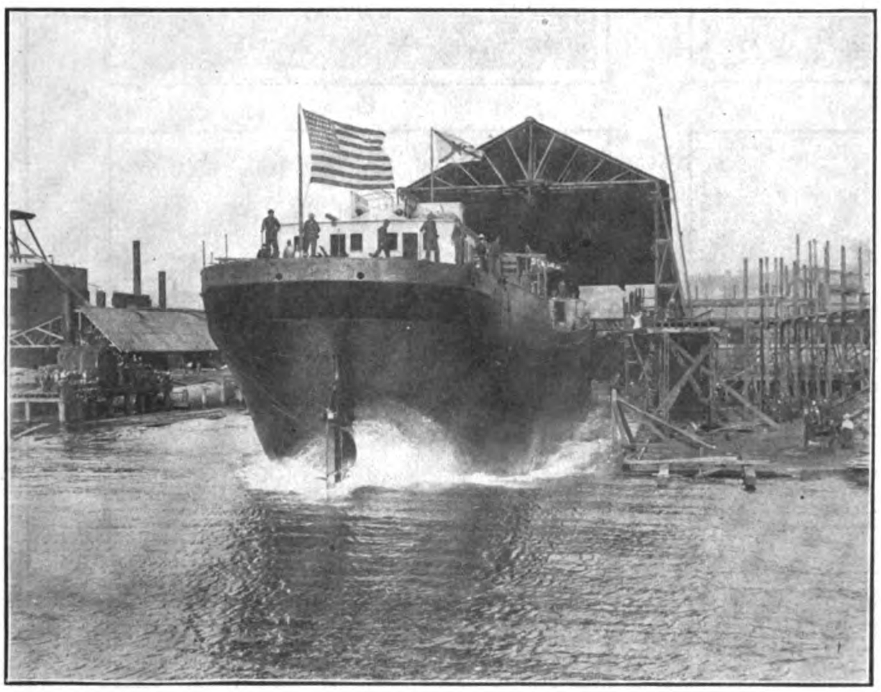
THE MORAN COMPANY

History and Description of a Representative Pacific Coast Ship Building Plant

BY H. COLE ESTEP

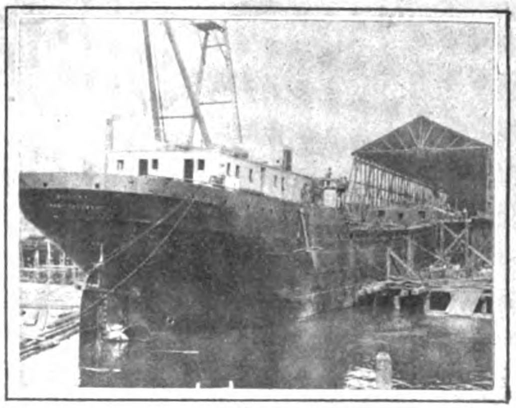


LAUNCHING A MERCHANT VESSEL AT THE MORAN COMPANY'S YARD.

Occupying practically twenty acres of land in the heart of the manufacturing district of Seattle, the present plant of the Moran Co. stands as a monument to the enterprise and genius of one man, Robert Moran. In the short space of twenty-five years he built the business up from nothing to a point where it requires the largest engineering establishment on the northwest coast. Mr. Moran and his brothers who were associated with him in the business, wisely preferring to complete their lives unannoyed by the cares that go with the management of a great enterprise, sold their interest in the firm in the early summer of 1906 to the Moran Co., which corporation is now operating the works.

Robert Moran, founder, president and leading spirit of the original firm of Moran Bros. Co. was born in New York, January 26, 1857. At the early age of thirteen he began working as a machinist's apprentice in a small shop at Montclair, New Jersey; four years later he was in Cincinnati doing a man's work in a rolling mill. In 1875, then 18 years of age, he arrived in Seattle without money or friends. For the next seven years he was employed on various steamboats engaged in trade between Puget Sound and Alaska. In 1882 he quit steamboating and established a small machine shop on the only wharf then existing in Seattle; his brothers joined him and the firm of Moran Bros. Co. was organized.

Times were good, the Northern Pacific railroad was just completed, and by 1889 the firm owned a modern shop established on broad lines and was doing a good business. In this year the plant was totally destroyed by fire, but was immediately rebuilt on a more extensive scale on the site that it now occupies. In 1890 the firm built its first steamer, the Seattle fire boat "Snoqualmie," a small, wooden craft that is still in service. Mr. Moran had an ambition to build a battleship, and by 1901 the plant had, through his careful management, attained sufficient size and capacity to undertake such a contract. He bid on and was successful in getting the contract for the battleship "Nebraska" at a price of \$3,733,000. The plant was enlarged for this work, many new tools were purchased and on July 4, 1902, the keel of the "Nebraska" was laid. She was launched October 7, 1904, made 19.237 knots on her trial trip July 16, 1906, and has recently been accepted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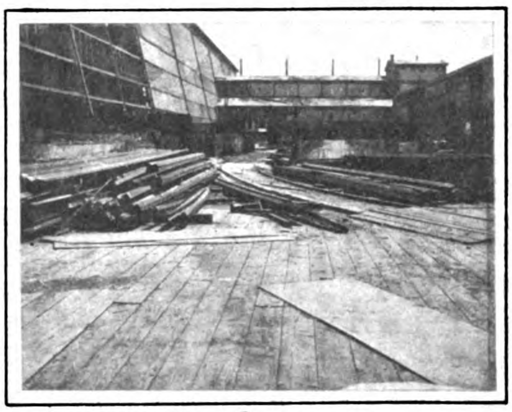
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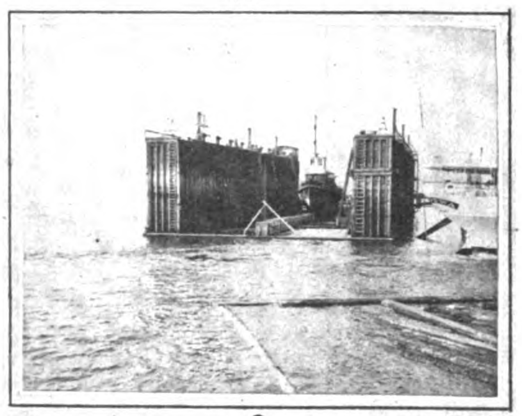
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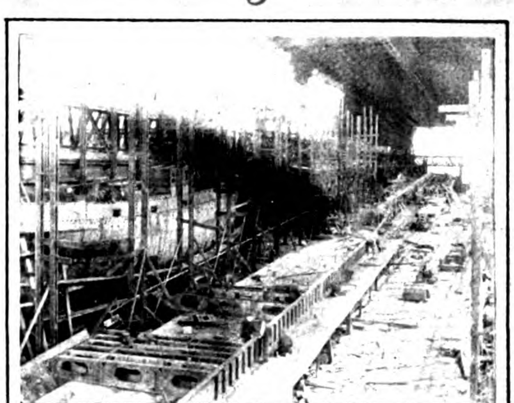
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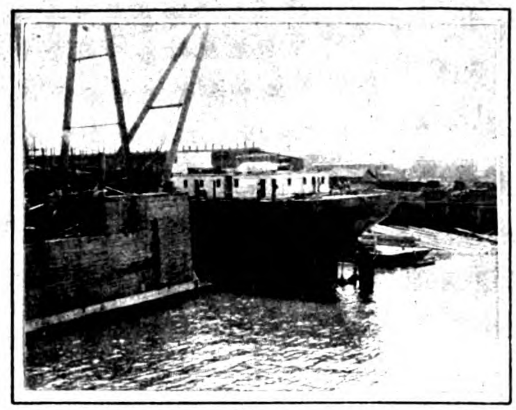
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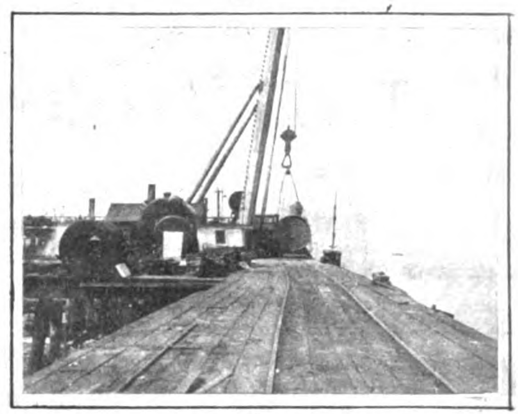
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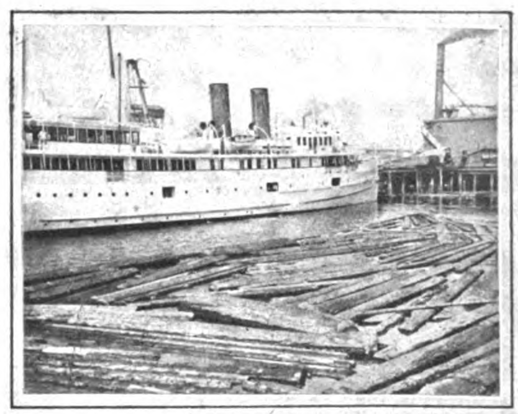
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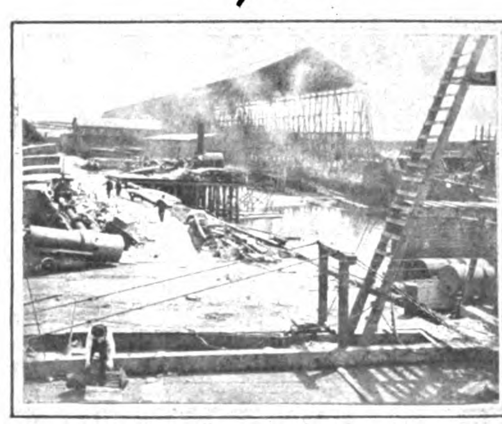
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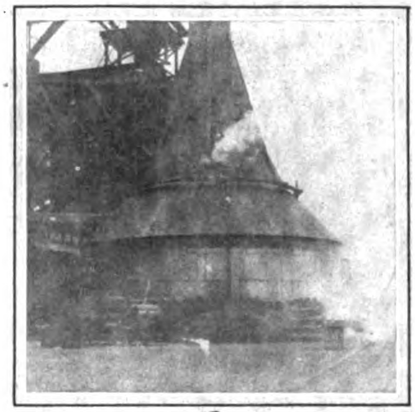
1.—"SEWARD" AFTER LAUNCHING.
2.—STEEL PLATE STORAGE YARD.
3.—FLOATING DRY DOCK.
4.—INTERIOR OF SHIP BUILDING SHED.

5.—100-TON FLOATING DERRICK WORKING ON "SEWARD."
6.—SHEAR LEGS ON WHARF.
7.—S. S. "IROQUOIS" UNDERGOING REPAIRS.
8.—SHIP BUILDING SHED AND DOCKS.



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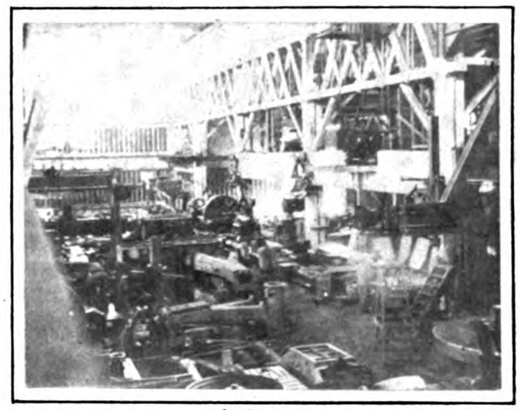

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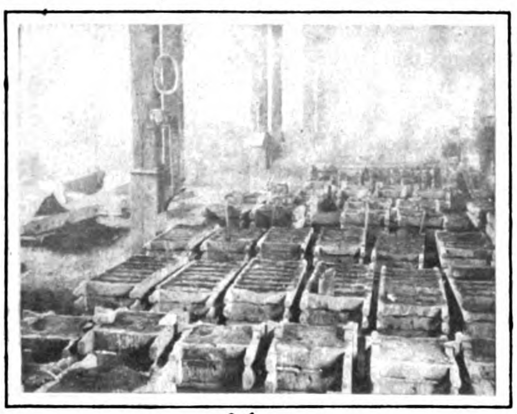

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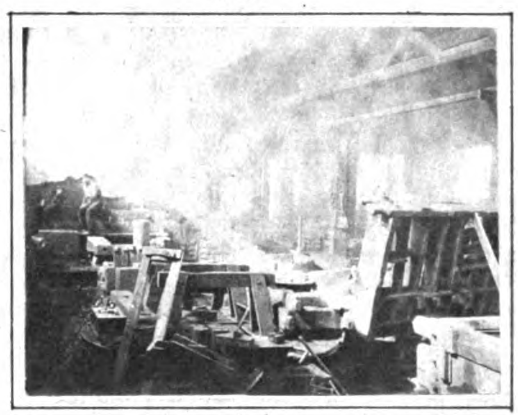

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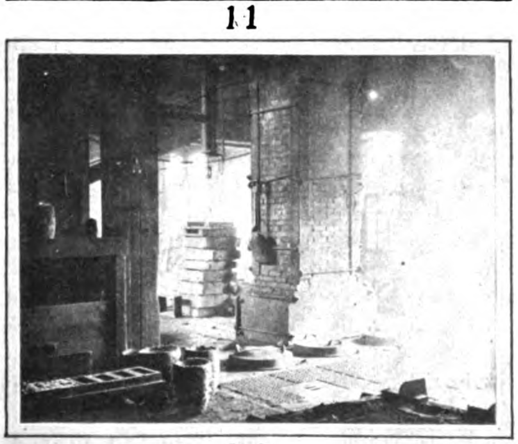

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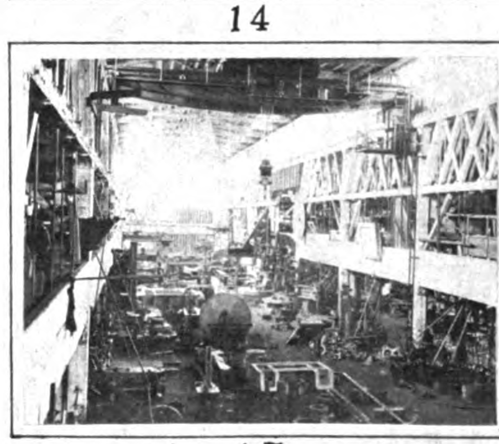

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9.—EXTERIOR OF REFUSE BURNING BOILER PLANT.

10.—SHIP BUILDING SHED.

11.—PORTION OF FOUNDRY.

12.—BRASS FOUNDRY.

13.—MACHINE SHOP LOOKING NORTH.

14.—FOUNDRY.

15.—MACHINE SHOP LOOKING NORTH.

and placed in commisison by the government. This, in brief, is the history of the pioneer ship building firm of the north coast, a description of whose work follows:

The company carries on three distinct lines of business; it runs a saw mill having a daily capacity of 70,000 board feet, making a specialty of long, clear sticks suitable for ship building purposes; it operates a steel and wood ship building yard fitted out to construct anything from a life-raft to a battleship; and in addition does a large amount of general engineering work. The firm manufactures no standard lines of machinery but is prepared to do anything to special order.

The works are situated on a plot of ground 1,200 by 700 feet, the narrow side fronting on the water, near the head of Elliott Bay on Puget Sound at Seattle. The property is well situated and accessible, fronting on deep water on one side and on Railroad avenue on the other. Although the plant was not designed as a unit but was constructed gradually as the necessities of the business demanded, we find that the general layout of the yard is very good. Excluding the saw mill the shops are laid out in the form of a great T, 700 feet across the top with a stem 900 feet long. Six hundred feet of this stem are taken up by the steel ship building shed. The top of the T lies parallel to Railroad avenue; the left half, measuring from where the stem meets the top, contains the general offices, the machine shop, pattern shop and foundry. The right half contains the boiler shop, blacksmith shop and the ship - fitting shop. On the north side of the stem of the T is situated the saw mill, lumber yard and central power station; to the south of the stem are found the wood ship building yard and shop, the steel plate storage yard, woodworking shops and store rooms. There is one weakness in the general design of the plant, it does not easily admit of enlargement and extensions. The foundry and machine shops are already crowded to their full capacity and when the demand comes for increased facilities difficulties will be encountered. The only feasible direction for extending the works is toward the south and if any extensive shops were located in this region the problem of economically handling the material would become complicated.

As the plant stands at present the T layout permits a system of internal transportation that is at once simple and efficient. The ship building shed is the center of operations. The foundry and machine shop lie parallel and castings from the former can be taken directly into the machine shop, from which they go straight to the ship building shed. At the same time the lumber from the mill can be brought directly to the shed through one side, while boilers, plates, etc. from the wrought metal department enter from the south without interfering with the material from the machine shop, foundry or mill. Since the various shops are placed on opposite ends of the top of the T the interchange of material between them takes place rapidly and economically. To accomplish this internal transportation the plant is provided with the usual arrangement of surface tracks and traveling cranes. A standard gage railway reaches every part of the yard; in addition each shop is provided with its own system of overhead traveling cranes. For handling heavy machinery in ships lying alongside the docks the company has provided a 75-ton shear legs on the north side of the wharf, and in addition a floating derrick of 100 tons capacify.

On account of the long distance from the source of supply the company is forced to carry a stock of plates, angles, bars and raw materials about 50 per cent heavier than is required for an eastern plant. The firm must be prepared to make quick deliveries to its customers and inasmuch as it often takes six months to get material delivered from the east, a heavy stock is necessary. This results in an extensive and well arranged stores system. Aside from the lumber which is stored in a yard near the mill and the pig iron which is kept near the foundry, the stores are arranged in a long building lying parallel to the ship building shed. This structure is 400 by 40 feet, two stories high. The bars and lighter plates are arranged in racks on the lower floor; the miscellaneous small stores are kept on the second floor. The heavy plates are stored edgewise in a yard 400 by 90 feet in size situated between the main stores building and the ship building shed. A railroad extends the full length of this yard and the plates can be easily reached by a portable derrick. The general ararngement being such that all the material is easily accessible, the prime requisite of a successful stores system is fulfilled.

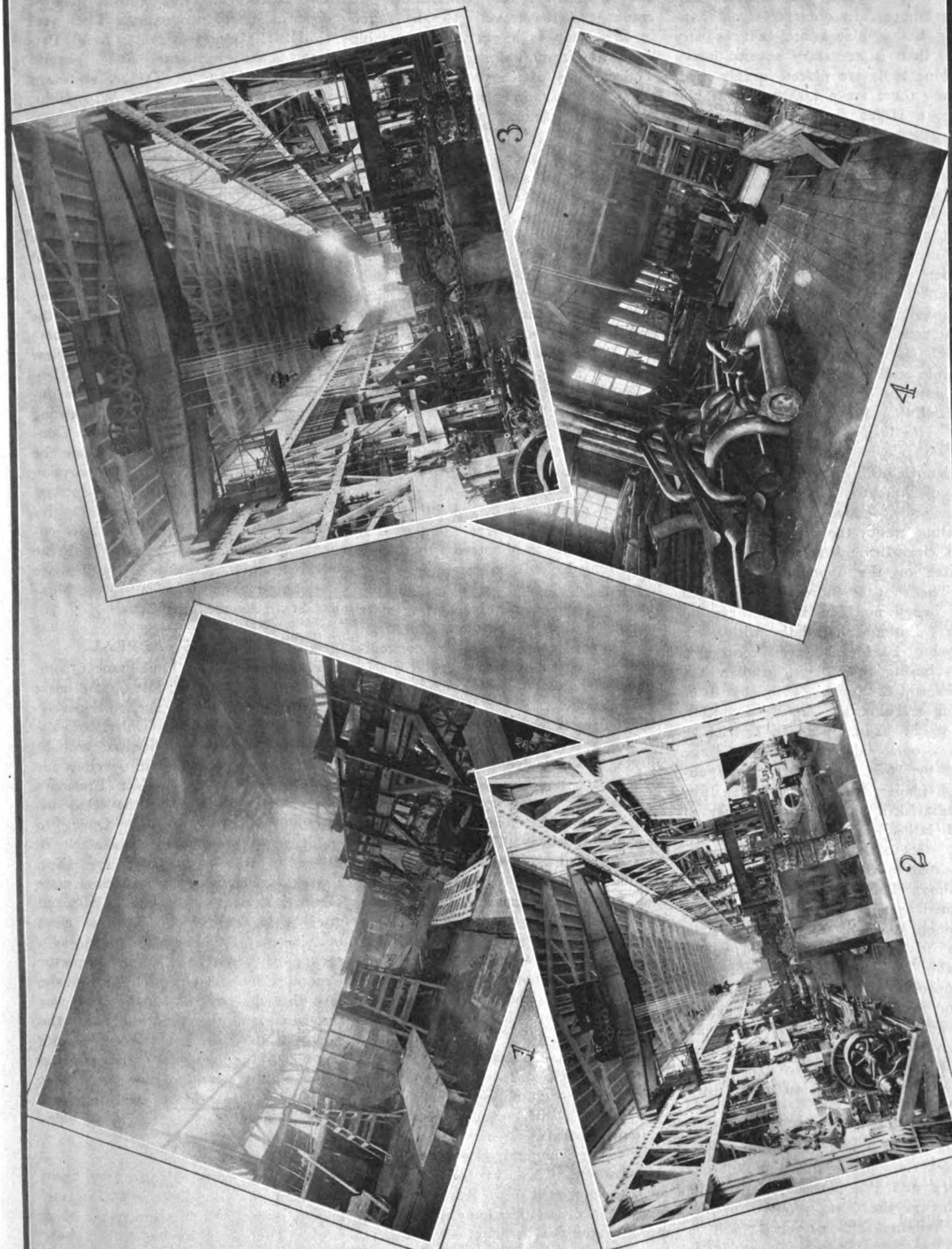
The plant has a central power station containing two 1,000-horsepower vertical, compound, condensing engines, also one 400-horsepower and two 125-horsepower high speed automatic engines. The total capacity of the plant is 2,650 horsepower. One of the 1,000-horsepower engines drives the saw mill direct; the others drive generators which furnish electricity for light and power throughout the plant. The tools in all the shops are motor driven; the lighter machines are arranged in groups driven from one motor, the heavy machine tools are individually driven. The system uses direct current and presents no unusual features.

The boiler plant is decidedly unique. Twelve vertical, multitubular boilers five feet in diameter and 18 feet long are arranged in a circle 19 feet in diameter. The boilers rest on a concrete foundation; the tops are covered by a large conical sheet iron shell terminating in the steel stack eight feet in diameter. The grates are circular, arranged in a flat cone two feet higher at the apex than at the base. Inside the ring of boilers is a circular combustion chamber 14 feet in diameter and, including the internal dome that covers it, 24 feet high. Leading into this chamber is a large hopper. The refuse conveyor from the saw mill drops the slabs, ends of boards, etc. into this hopper from which they are automatically fed into the combustion chamber. The chamber is usually half full of burning refuse. The hot gases and products of combustion pass under the boilers, up through the tubes and out the stack in the ordinary manner. The plan is practically automatic; one man on each shift operates it easily. The material burned is wasted by the average Pacific coast mill, but on account of this arrangement the saving in fuel alone, at the present prices of coal, is over $100 a day.

For repair work on ordinary steamers the plant is equipped with a floating dry-dock 200 ft. long, 55 ft. wide and 30 ft. deep. This dock can handle all ordinary vessels plying between Puget Sound and Pacific coast ports.

The wood ship building yard is 300 ft. by 90 ft. and the adjacent shop and mold loft is 400 ft. by 60 ft., the mold loft being on the second floor. The wooden ships are launched sideways.

The steel ship building shed is an open side, wood frame structure 600 ft. long by 110 ft. wide. It is easily accessible from all sides; the launching ways at the west end drop immediately into deep water. The shed contains four 5-ton traveling cranes with a span of 50 ft. there being two cranes on each runway. At the east



1.—SHIP BUILDING SHED LOOKING TOWARDS BAY.
2.—MACHINE SHOP LOOKING SOUTH.
3.—MACHINE SHOP LOOKING SOUTH.
4.—CORNER OF PIPE SHOP AND COPPER SHOP.

end of the shed these cranes connect with those serving the machine and boiler shops. In order to avoid handling heavy plates and shapes any more than is necessary several heavy machine tools are placed in this shed. Among these are a 1,000-ton hydraulic press, a Hilles & Jones plate planer taking a plate 24 feet long, and a heavy Hilles & Jones shears having a gap of five feet.

Adjacent to the east end of the ship building shed is the pipe and sheet metal working shop 100 by 140 feet in size and fitted to work the heaviest sizes of brass and copper pipe. This building also contains the galvanizing and japanning plant.

The machine shop, 100 by 300 feet, is well lighted by large windows in the side wall and ventilator overhead. The interior is painted white which materially aids in distributing the light. The design of the shop is standard, with a wide gallery extending the full length of both sides carrying the light machine tools. The central bay, 40 ft. wide, is spanned by a 30-ton traveling crane; the crane runway extends clear through to the boiler shop situated on the opposite end of the T. The shop is thoroughly equipped with heavy machine tools; these include a Putnam shaft lathe with a six ft. swing, 50 feet between centers, a Betts boring mill 24 ft. in diameter, a Beaman & Smith 24 in. by 8 ft. milling machine, a 24-in. Betts slotter, a 42-in. by 42-in. by 16 ft. Detrick & Harvey open side planer, and a large 96-in. by 96-in. by 16 ft. Betts enclosed planer, together with a five ft. radial drill and the usual array of small lathes, drills, mills and other tools. Out of necessity the tool room is located in the southwest corner of the shop. This arrangement obliges the men working at the north end of the shop to walk about 500 feet in going to and from the tool room, probably wasting fifteen minutes in the process. Most of the tools are ground in the modern way by expert tool grinders in the tool room, although some of the experienced machinists are permitted to grind their own tools according to their own ideas.

Adjacent and parallel to the machine ship is an 80 by 280 ft. building containing the gray iron and brass foundry and the pattern shop. The foundry is the least modern of the shop buildings; its principal fault is poor lighting. In equipment it is modern and adequate; a 25-ton double girder traveling crane spans the molding floor. A great many Pacific coast foundries are fitted with a row of uneconomical, space consuming jib cranes and the traveling crane found in this shop is a very commendable departure from the prevailing practice. The capacity of the two cupolas is 21 tons and the shop is prepared to make gray iron castings up to 20 tons each.

The boiler shop, blacksmith shop and ship fitting shop occupy a building 200 by 240 ft. deep in size located at the opposite end of the T from the machine shop and foundry. The boiler shop is 95 by 150 ft., fitted with its own traveling crane and with tools adequate to construct the largest double ended marine boilers. The large bending rolls will take a 25-ft. plate. The smith shop is 95 by 90 ft., contains 14 fires, two bar furnaces, a 20-ton steam hammer and a 200-ton hydraulic press, together with other light hammers and forging presses. The hammers are served by individual air hoists. The ship fitting shop is 105 by 240 ft. and contains a plate furnace 13 by 22 ft., also two bar furnaces, one 60 ft. long by 4 ft. in diameter, the other 31 ft. long by 3 ft. in diameter. These furnaces are fired with crude oil, atomized by an air blast, the plate furnace has three burners, the large bar furnace ten. Besides its convenience and cleanliness the crude oil is much cheaper in this region than coal or coke.

The firm realizes the importance of providing for the welfare of its employes. Extensive lavatories and lockers are provided for the men in a two-story building situated convenient to the machine shop and shipbuilding shed. The company also runs a restaurant which serves a substantial lunch to the officers, foremen and heads of departments without charge. This feature is very commendable as it gives the heads of departments a chance to get together, become acquainted and exchange ideas relative to their work. The application of the idea should be extended.

The Moran Company, which took charge of the works a year ago, has followed a wise and progressive policy; it has spent considerable money in improvements and has done a great deal to perfect and systematize the organization. This work is now going on and the next few years will see many improvements along the line of more economical production and better organization. The company is making a valiant and commendable fight for the open shop principle. The capitalization is $2,000,000 and the plant employs about 1,000 men. The officers are well known men of experience and originality. They are: G. H. Higbee, president; J. V. Paterson, vice-president and general manager; Chas. D. Taylor, secretary and treasurer; and F. W. Hibbs, superintending engineer.

NEW FIELD FOR MORGAN LINE.

It is reported that the Morgan line of steamers, controlled by the Southern Pacific railway, is to announce at once the establishment of a definite schedule of combination passenger and freight boats between New Orleans and Galveston and the important Mexican ports along the gulf. This line already has steamers in operation between Galveston and New Orleans and New York and other Atlantic seaboard ports and it is now the intention of the line to build up a strong business with the Mexican coast. Tampico and Vera Cruz are to be made the main shipping points. In this connection it may be mentioned that there are strong possibilities of a combination of the independent steamship companies now engaged in traffic in this territory with the new enterprise, including as well those lines now engaged in traffic between Mexico, South America and Cuba.

FRANCKE'S APPEAL.

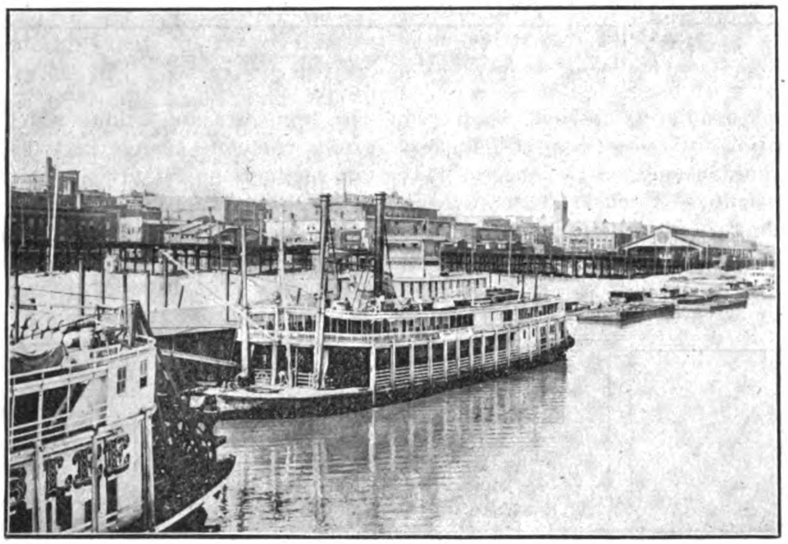
The appeal of Capt. Emil Francke, commander of the Dakota, lost on the coast of Japan a few months ago, to Supervising Inspector General Uhler, of the steamboat inspection service, has brought him a reply censuring him severely for the loss of his ship. Capt. Francke's license was revoked by the local inspectors at Seattle, Wash. Owing to the fact that the license was about to expire it will be possible for Capt. Francke to obtain papers as a chief mate of ocean steamers after Jan. 1, 1908 and after having served two years as chief mate he may again obtain a license as a master of ocean steamers. Inspector General Uhler's letter to Capt. Francke says that the desire to make time was paramount and that precautions for the safety of the ship and its people were thrown to the winds according to the evidence. He, therefore, concludes "that no man who is guilty of such carelessness is immediately fit for another command."

The car ferry Manistique and Northern No. 1 collided with an unknown steamer off Manistique last week. The car ferry had a 3-ft. hole punched in her side below the rail by the anchor of the colliding vessel, but neither boat was seriously injured.

STEAMBOAT ARCHITECTURE ON THE WESTERN RIVERS

BY MELVILLE H. KIEL

The steamboats of the western rivers are as characteristic of the Mississippi and its tributaries as the sampans are suggestive of the Yangtse-Kiang, or the dahabiyehs of the Nile. Designed to perform a particular service under exceptional conditions, they constitute a distinct type of marine structure. No form of craft yet devised, exhibits so many features of primitive ingenuity and economical construction, combined with such comparative efficiency, as do these unique vessels which carry on the commerce of our inland rivers. Adaptability to existing conditions has been the dominant factor in determining their form and arrangement.



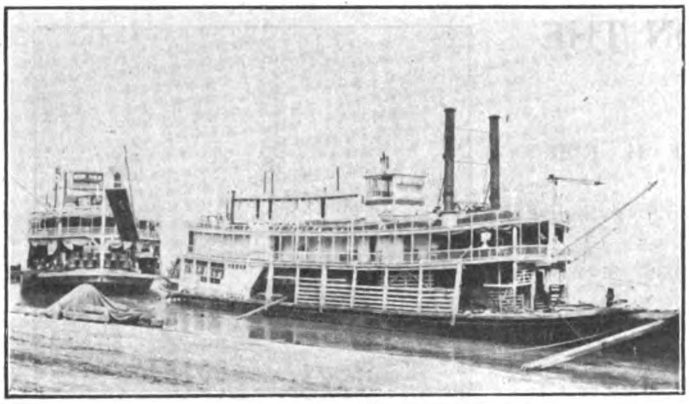
LYING ALONGSIDE THE WHARFBOAT AT LOUISVILLE, KY.

When steam navigation was first successfuly introduced on the vast system of rivers which converge in the Mississippi, the improvement of these streams had never even been considered. Their channels were for the most part shallow and extremely tortuous, retaining no permanent location, but constantly drifting as the action of the current wore away the banks. Snags, boulders, and obstructions of every sort abounded—a constant menace to navigation. Moreover these rivers have always been subject to great variations in height, caused by the irregular water supply. During the annual spring floods, the water level may be raised to 60 or 70 ft. above the normal, while the dry summer season may reduce these streams to a mere succession of shallow pools with hardly enough water to preserve their continuity.

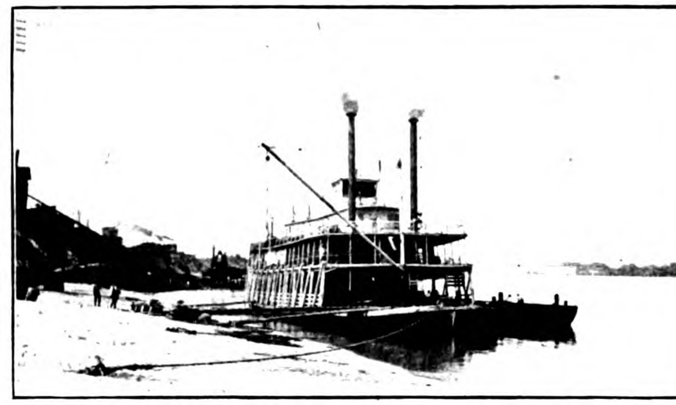
STEAMER ISLAND QUEEN AT CINCINNATI.

THE LANDING STAGE.

Conditions of such unfavorable nature confronted those who first attempted to establish regular and reasonably safe river transportation in the Mississippi valley. The flat boats and broad-horns of the pioneer trader, which at that time represented the most successful craft in service on the inland rivers, naturally furnished the pattern from which the steamboat was evolved. They had already demonstrated their adaptability to the navigation of these erratic streams, and it only remained to provide them with motive power so that they could be mechanically propelled. The development of the Western River steamboat, in essentially its present form, from this primitive arrangement was rapid, and remarkable for the uniformity in design which it produced. Hardly a score of years had elapsed after the introduction of steam as a propulsive agent, before hundreds of these unique craft were in service on the Ohio, the Missouri, the Mississippi, and other navigable streams of the interior.



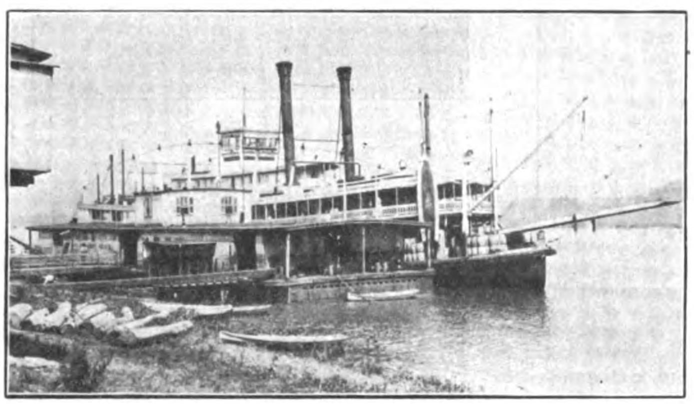
TIED UP TO THE BANK.



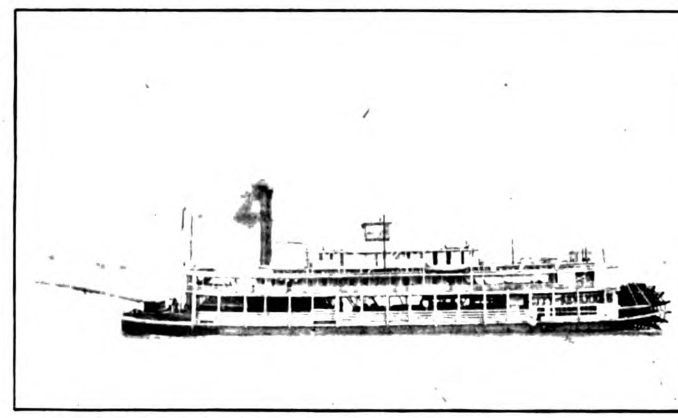
A LOWER MISSISSIPPI RIVER STEAMBOAT.

Steamboat architecture on the western rivers has changed but slightly since the day when river traffic had attained the height of its splendor and prosperity. Not because anything like finality in efficient design had been reached, but because the decline of river commerce has discouraged the adoption of modern methods and appliances. The absence of adequate river improvement, and consequently unreliable navigation, is in a large measure accountable for the apparent lack of enterprise which the transportation companies seem to manifest. Natural conditions which hampered navigation fifty years ago still impose their burdensome restrictions, so that the slight difference between the steamboat of today and its progenitor of half a century ago is not altogether due to the non-progressive character of the men who own and operate them. Investment in steamboat property, at the present time, is an unprofitable venture, and it is little wonder that modern improvements, involving increased expenditures for construction and operation, should not be more favorably received. However, signs are not lacking which indicate a complete change in transportation methods on the principal rivers of the Mississippi system.

To one accustomed to the vessels in service on the other rivers of America and of Europe, the arrangement of the western river steamboat is strange and unfamiliar. Charles Dickens in his "American Notes" gives a description of a boat in which he journeyed from Pittsburg to Cincinnati, which is at once amusing and illustrative of the failure to properly appreciate the strong points in a

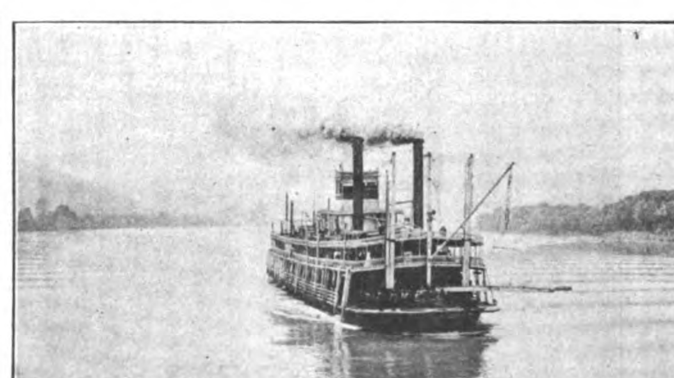


STEAMER VIRGINIA OF THE PITTSBURG & CINCINNATI PACKET CO.'S FLEET.



A TENNESSEE RIVER STEAMBOAT.

A MONONGAHELA RIVER PACKET.



STEAMBOAT OF THE UPPER MISSISSIPPI.

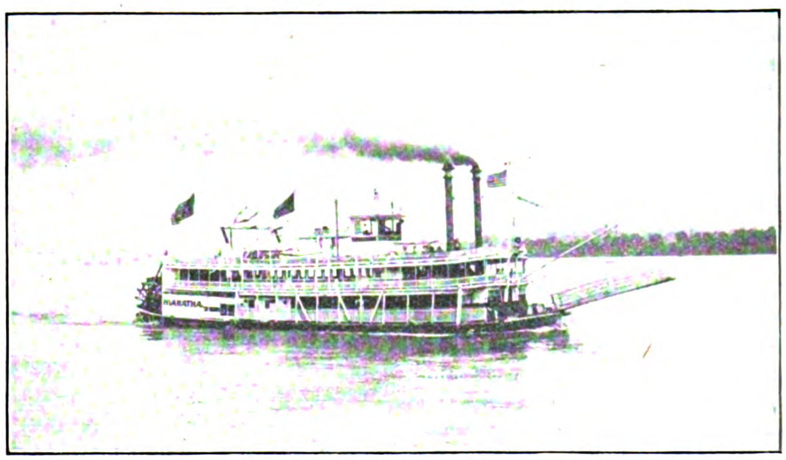
steamboat's design, of those to whom any sort of floating craft which does not exhibit the features of a deep sea vessel, is nothing more than an unsightly ark or ungraceful barge. The appearance of the Pittsburg boat must have rudely disturbed his preconceived ideas of a river steamboat for he says: "In the first place, they have no mast, cordage, tackle, rigging or other such boat-like gear; nor have they anything in their shape at all calculated to remind one of a boat's head, stern, sides, or keel. Except that they are in the water, and display a couple of paddle boxes, they might be intended for anything that appears to the contrary, to perform some unknown service, high and dry upon a mountain top. There is no visible deck, even; nothing but a long black ugly roof, covered with burnt-out feathery sparks; above which tower two iron chimneys, and a hoarse escape-valve, and a glass steerage-house. Then, in order as the eye descends towards the water, are the sides and doors, and windows of the staterooms, jumbled as oddly together as though they formed a small street, built by the varying tastes of a dozen men; the whole is supported on beams and pillars resting on a dirty barge, but a few inches above the water's edge, and in the narrow space between this upper structure and this barge's deck, are the furnace fires and machinery, open at the sides to every wind that blows, and every storm of rain it drives along its path........Within, there is one long, narrow cabin, the whole length of the boat; from which the staterooms open, on both sides. A small portion of it at the stern is partitioned off for the ladies; and the bar is at the oposite extreme. There is a long table down the center, and at either end a stove. The washing apparatus is forward, on the deck."

This is scarcely an attractive picture, but in fundamental details it is essentially correct. It must be remembered, however, that nothing in America, and especially in western America, escaped the caustic wit of England's popular humorist, and it was apparently his purpose to represent conditions beyond the Alleghenies in as ridiculous a way as possible.

This somewhat vague and incomplete description is given merely to convey a general idea of the steamboat's appearance and arrangement. It will be desirable to set forth in greater detail their characteristic features.

The first particular which the observer will in all probability notice is the form and construction of the hull, or the barge-like structure which masquerades under that name. It possesses neither grace nor symmetry, and has evidently been built from the utilitarian point of view and not from the aesthetic. A full model with a long parallel middle body and blunt ends is an absolute necessity in order that sufficient displacement may be obtained. This does not result in any great loss of propulsive efficiency, as the speed of these boats is comparatively low. The lines of a side wheel boat are not so great a departure from the conventional style, since the location of the machinery does not require anything extraordinary in this respect, as are those of a stern-wheeler. In this type of boat the bows are particularly bluff, and the water lines, instead of converging at the stern, end abruptly on the transom. The width at the stern is almost as great as amidships. To prevent the formation of eddies, and to allow a free flow of water to the rudders and wheel, the bottom is raised at the after end so that the stream lines, instead of flowing from either side toward the center, rise in parallel directions from the keel. There is scarcely any dead rise; in fact, some are built with perfectly flat bottoms. The turn of bilge is extremely sharp, merely a slight rounding off of the edge, formed by the juncture of the sides and bottom.

Steel as a material for the construction of hulls has not been employed to any considerable extent on the western rivers. Wood is almost exclusively used for this purpose. The arrangement of the material in wooden steamboat hulls is very similar to that ordinarily adopted in the construction of barges and floats. The sizes of timber used are comparatively light and are nowhere nearly as heavy as those usually found in the hulls of sea-going vessels. Longitudinal strength is the great desideratum, and consequently as much of the framing is disposed in a fore and aft direction as possible. The method of planking is in accordance with established practice, but, except at the extreme ends, is usually a very simple operation, as few of the individual planks require shaping of any sort. Water tightness is secured by calking in the ordinary way, but is not as carefully done as in sea-going vessels because the decreased water pressure resulting from the shallow draught does not require it. To provide against the excoriating effect of ice and running drift the bows are sheathed with sheet iron run in vertical strakes and nailed to the wood planking.



HIAWATHA, A STEAMBOAT OF THE EXCURSION TYPE.

The location of the permanent weights in these shallow draught vessels, subjects their hulls to excessive longitudinal stresses. In a stern-wheel boat the engines are unavoidably located at the extreme after end which, in order to maintain a proper trim, necessitates placing the boilers considerably forward of amidships. This extreme separation of engines and boilers results in enormous hogging stresses, which are still further accentuated by the heavy wheel and pitman at the after end, and the landing stage, capstans and other deck gear on the "head," as the forward part of the main deck is called. The shallow hull is manifestly incapable, in itself, of resisting such excessive stresses. The necessary supplementary strength is furnished by a system of two overhead longitudinal girders extending nearly the entire length of the boat. Their arrangement is very simple, merely consisting of an iron rod of

circular section which is securely bolted to a keelson near the bows, and supported in an arched position, at about the height of the "Texas," by substantial wooden struts, finally passing over the heavy framing which supports the wheel and terminating in the structure which carries the shaft bearings. Turnbuckles are provided so that any slack which may occur can be readily taken up and the whole girder kept taut and rigid. It is usual to have the highest point of these girders at the after end where the greatest weight occurs, but occasionally they attain their greatest elevation amidships. This plan has been adopted in the construction of the Virginia and Queen City of the Pittsburg and Cincinnati Packet Co.'s fleet, whose lofty "hog chains" form an enormous circular arc with the highest point about abreast the pilot house.

The extraordinary flexibility of these wooden hulls is remarkable. They can stand an amount af racking and twisting without starting a seam, that would have streams of water pouring into a deep sea vessel constructed of the same material. The steamer Virginia before referred to was on one occasion nearing Pittsburg when she grounded on the point of a bar. Instead of accomplishing this misfortune in the orthodox fashion and striking bow on, she ran afoul of the bar amidships, leaving the ends entirely unsupported. For an instant she hung suspended in this perilous position, when suddenly the starboard hog chain snapped with a report like that of a gun. The tremendous and extraordinary stress now imposed on the port chain was resisted for a few moments, but the enormous strain soon parted it also allowing the stern to drop about 18 in. This bending, together with the local disturbance which it caused, permitted the boat to drift off into deeper water. Examination soon disclosed the fact that she was making very little water, but that the hull timbers were under a fearful strain, although the natural elasticity of the material prevented a complete rupture. As quickly as possible all freight and other heavy weights were shifted from the ends to amidship, which relieved her to such an extent that she was able to proceed under a "slow bell" to her destination in safety. That trip has ever since been memorable in river annals. Deprived of the rigid support of her hog chains, the pliable hull responded with sinuous movements to every impuse of the paddle-wheel, and set bulkheads, partitions and decks, groaning and cracking like an old house in a storm. When she was finally hauled out on the marine ways it was found that she had sustained no serious damage at all. Her stern was jacked up to its proper position; new chains were fitted and she is in service today performing her usual duties as well as before the accident. This experience was somewhat unusual, but the rough handling and frequent groundings to which these boats are subject, continually tends to produce a more or less serious deformation of the hull. Occasionally they get an unusually severe bump and then the deformation becomes permanent and manifests itself by a broken and irregular sheer line.

Side-wheel steamers have all their machinery located amidships so that no special precautions are taken to provide longitudinal strength, beyond disposing the material in the hull so as to be capable of resisting all probable stresses, both longitudinal, which are the most severe, and transverse, which are also quite important on account of the weight and impact on the water of the heavy wheels.

All steamboats are provided with overhanging guards, primarily to increase the deck space as much as possible, but they are useful also in preventing damage to the hull in case of a collision. These guards are not fitted with spondels or sustaining brackets of any sort, as they would be damaged or carried away by floating drift, but are supported by running the wooden main deck beams out to the heavy fender. The extension of the guards in side-wheel boats is frequently too great to permit of providing sufficient strength in this way; so additional support is furnished by a system of iron rod trusses under the boiler deck, with their outer extremities attached to the fender. On account of the extreme draught to which these boats are often loaded, the transverse line of the guards does not follow the main deck camber, but is inclined upward from the line of the hull outward to the fender. If this were done the guards would be constantly trailing in the water whenever a heavy cargo was carried.

The construction of steel hulls on the inland rivers has not been sufficiently extensive to result in any well established practice in regard to structural arrangement and sizes of scantlings. However, the tendency seems to be toward very light construction and so far the methods of disposing the material are more in accordance with the practice of the structural iron worker than of the ship builder. With the constantly decreasing supply of suitable timber and the adaptability of steel to the purpose, without an excessive increase in cost, it does not seem as though wooden construction, at least for passenger boats and towboats of the first class, could long survive.

But if the raft-like hull bears so little resemblance to the usual form of floating structures, the propelling machinery is no less dissimilar to the ordinary mechanical devices for the propulsion of ships. There is not that elaborate installation of boilers, engines, and auxiliaries which marine engineers usually consider necessary to a complete and efficient machinery equipment. As with the steamboat itself, so with its propelling apparatus, everything is made subservient to simplicity, and adaptability to conditions which are far from being ideal. This finds particular exemplification in the type of boiler which has been almost universally adopted. Many circumstances have contributed toward determining its many peculiar features.

There is no available source from which the boiler feed water may be obtained, except from the river itself, which even in its most clarified state holds large quantities of earthy and vegetable matter in suspension. The introduction of such muddy water into the ordinary type of internally fired boilers, and its conversion into steam, would result in such a loss of heat efficiency as to render their use undesirable. Hence the externally fired large flue boilers, of exceptionally ample grate surface in proportion to heating surface, has been devised; which permits using the raw, unfiltered river water, without entailing a wasteful expenditure of fuel. It is true that this type is not especially economical in its use of fuel; but then one cannot expect any very great economy where the bottom blow-out is being constantly used to remove the accumulation of solid matter, which results from the evaporation of the water, and when half of the heat energy is unable to pass through the deposit of non-conducting material which continually forms on the flues and interior of the boiler shell, and which appears to resist the efforts of all boiler compounds to eradicate. However, they possess a fair amount of steaming ability, and on account of the comparatively small amount of water which they contain, respond with considerable

facility to the fluctuating demands of the engines, when alternately starting and stopping at short intervals. This ability to hold steam is a most important feature when a steamboat is maneuvering in a narrow channel, or making a landing, as the situations are often critical and frequently require a full head of steam without an instant's delay.

Another feature which especially adapts them to service in a steamboat is their remarkably light weight. The steam pressure carried varies from 165 to 185 pounds, but their small diameter, rarely exceeding 36 in., permits using very thin boiler plates, and the absence of combustion chambers, stay-rods and boiler tubes results in an enormous decrease in weight over that which would ordinarily be found in other steam-producing apparatus of the same power.

But what is particularly advantageous to the frail hull of a steamboat, is that the weight, instead of being concentrated, is distributed over a considerable distance fore and aft. When one considers the great disparity between the weight of the boilers above and the buoyant force immediately beneath, resulting in the production of enormous local stresses which the shallow hull is ill adapted to resist, it will be seen what great importance attaches to this fact.

Some kind of mechanical draft is necessary in order that the size of the boiler plant may be as small as possible, in proportion to the power of the engines. The construction of the furnaces and the open, exposed character of the fire room is unsuitable to the use of forced draft. Consequently induced draught is used exclusively, either taking the form of directing the exhaust steam from the engines into the smoke stacks and thereby creating a partial vacuum, or else fitting separate blowers in the uptakes. The former is objectionable on account of the resulting tremendous noise which resembles the roaring of a volcano, so that the latter is more often found on passenger boats of the better class.

Western river steamboats, whether of the side or sternwheel type, are invariably fitted with two distinct and separate sets of engines. This arrangement is obviously necessary in the case of the latter, but it is desirable in the former also, on account of the ability to operate the side wheels independently, which it permits. These engines are of the inclined or horizontal type, and are usually simple expansion. Compound engines when adopted at all, have been exclusively applied to sternwheel steamers, where the high and low pressure cylinders have been arranged tandem, both pistons operating on one rod, which is directly connected to the ponderous pitman.

Condensers are rarely used, the exhaust steam being generally allowed to escape directly into the atmosphere, or directed into the smoke stacks, in order to increase the draft to the furnaces. However, a number of boats have recently been equipped with condensers of the jet type. No attempt is made to use the condensed steam for boiler feed; the condenser being intended merely for the purpose of giving the engines the benefit of the vacuum which they provide.

Valve gears, auxiliaries, and other appurtenances of this type of engine differ entirely from those to which the marine engineer is accustomed, but they cannot be described very well without greater elaboration than the length of this article will permit. Suffice it to say that they are admirably adapted to the engine in its present form. but in action are heterodox in respect to all accepted traditions of the deep sea engineer.

But there is one feature of the steamboat which cannot fail to attract attention, and that is, the ingenious instrument which converts the power of the engines into propelling force. The tremendous cataracts of yellow water which they raise, and the enormous swells which result, are the familiar sights which accompany the passing of a river steamer. Paddle wheels of the radial type have, so far, been used to the exclusion of every other form of propeller. The reason for this lies in the fact that paddle wheels possess an essential quality which is of paramount importance to a steamboat, and that is, equal efficiency in backing and going ahead. Without it no form of propeller can be of much service to a steamboat which is entirely dependent on this feature in maintaining its self-control.

Feathering paddle wheels have not been experimented with as yet, on account of the danger to their mechanism from heavy drift, but an attempt has been made in some sternwheelers to reduce vibration by setting the floats on one-half of the wheel, some distance ahead of those on the other half. This arrangement has been attended with a good deal of success, but of course does not result in any increase in propulsive efficiency.

The entire wheel, floats, rim, and arms, is constructed of wood, so that any damage can be quickly and cheaply repaired. This question of damage is an important consideration, especially to the floats, which are continually striking logs, smashing into the willows, and otherwise injuring themselves. The shaft is usually of hammered scrap iron, though in one or two exceptional cases nickel steel has been used. A prominent steamboat man has stated that nickel steel shafts, even when complying with the most rigid specifications have repeatedly failed, and that wrought iron seems to be the only reliable material adapted to the intermittent shocks which these shafts experience.

The steamboat must be under complete and perfect control at all times. If this were not so, they would be unable to navigate successfully in the swift current of the western rivers. Running under numerous bridges with narrow channel spans, and with treacherous cross currents constantly tending to swerve the boat from its course; effecting a multitude of landings in close and restricted quarters where stumps, branches. wrecks and other obstructions threaten to tear the boat's timbers asunder; and always borne on the surface of a rapid current, which renders steering a difficult matter, are conditions which constantly demand an unusual degree of steerability.

On account of the light draught it is impossible to provide this quality in stern-wheel boats without fitting several rudders instead of one. These are of the balanced type, and usually four in number, all hung in a row on the transom, forward of the wheel, and connected by a yoke to two tillers which operate together. In recent years a steam steering apparatus has been adopted on most steamboats, which consists simply of a steam cylinder placed athwartships underneath the boiler deck, with the piston rod connected through a movable arm to the tillers. Steam is admitted to either end of the cylinder by means of a valve which is operated through a system of rope leads by the steering wheel in the pilot house. In later styles of this apparatus the pilot does not work the steering wheel, but operates a lever placed immediately behind it. The whole arrangement is unusually simple and free from all complexity and hence is seldom out of order.

Cargo handling appliances are of a type peculiar to the western rivers. The most important of these is the portable gangway or landing stage which all boats carry for the purpose of affording a means of communication with the shore at landings where wharf boats are not per manently located. This "stage" as it is called in river parlance is a substantialy constructed platform 40 or 50 ft. long and about 6 ft. wide, suspended from a swinging boom by a bail, so as to leave an unobstructed passageway. A heavy upright spar is fitted at the forward end of the superstructure for supporting the boom in a way somewhat similar to that used in a jib-crane. The hoisting rope for raising and lowering the stage is led underneath the boom and down into the hold, where it is attached either to a winding drum on the capstan, or to a separate winch. The latter arrangement is much the more convenient and for that reason has been pretty generally adopted. Over this portable gangway the commerce of the river passes. Passengers embark and disembark by means of it and along its length every sort of package freight is carried, dragged and rolled by the crew of perspiring roustabouts. Practically all of this freight is loaded on the maindeck without any protection against bad weather except that provided by a tarpaulin cover, but if barrels, intended to be carried a considerable distance, form a part of the cargo, they are stowed in the hold. This is done by skidding them through a hatch over an ordinary barrel slide, and when needed, are hoisted out again by a primitive sort of cargo-winch.

Such is the steamboat of the western rivers; exhibiting little in its appearance or construction to attract attention or excite admiration. In its present form, its sphere of usefulness is fast diminishing, but even the advance of modern times will not cause it to entirely disappear for many years to come. With the improvement of these inland waterways, a new type will be developed which will be better adapted to modern conditions and requirements; but the ingenuity and experience of former days will contribute much toward its success. It was the river steamboat, crude and imperfect as it may seem when measured by modern standards, which originated and developed that once mighty commerce, whose magnitude and splendor added so tremendously to the wealth and importance of the middle west, and which transformed the wild and virgin wilderness of the Mississippi valley into a land of industry and unrivaled opportunity.

MISCELLANEOUS ITEMS.

The W. J. Oliven Manufacturing Co., Knoxville, Tenn., has received contract from the Isthmian canal commission to furnish 500 dump cars at $562,000.

Logan & Kennedy, of Chester, Pa., secured a contract from the Newport News Shipbuilding Co. to construct all patterns to be used for the castings on the new battleship Delaware.

During the equinoctial gale last week off the Newfoundland coast 75 fishing vessels were reported to have been wrecked and in the vicinity of a score of lives lost. The gale was the worst in 40 years and the monetary loss is estimated to have exceeded $250,000.

While the Italian Lloyds trans-Atlantic steamer Princess Yolanda of 12,000 tons, the largest emigrant ship ever built in Italy, was being launched at Rivatrigoso, near Spezia, she heeled over and rushed into the sea on her side, sinking with many workmen on board. They were rescued from their plight with difficulty. The damage is estimated at about 500,000 lire.

At the celebration of the opening of the new dock at St. Nazaire, France, recently, one of the features included the launching of the steamer Charles Roux, named after the president of the General Trans-Atlantic Steamship Co. The launching was marred by an unfortunate accident, the steamer sticking on the ways after her hull was two-thirds in the water. The cause of the accident was not discovered.

The armored cruiser Edgard Quinet, of 13,780 tons and 36,000 I. H. P., giving her an estimated speed of 23 knots, was successfully launched at Brest, France, Sept. 21. The cruiser is 515 ft. long, 70¼ ft. beam and draws 27½ ft. of water. She mounts fourteen 7.6-in. guns and twelve smaller rapid-fire guns. The vessel also carries two torpedo tubes. She was constructed at a cost of about $6,-500,000.

The only cable connecting America with the Orient directly, was put out of commission between Midway island and Guam recently by an earthquake and as yet communication has not again been established. The line is the one belonging to the Commercial Cable Co. and runs from San Francisco to Yokohama and the Philippines via Honolulu, Midway and Guam. Until the break can be repaired messages are being sent via the Atlantic, at a cost about double that of the direct line.

The new Russian battleship Emporer Paul, the first of that country's 17,600 battleships, was launched at St. Petersburg Sept. 7. She will cost when competed $8,500,000.

The Atlantic passenger rate war has had the result of reducing the first cabin fare to Europe and return to as low as $90 on some of the steamers of the International Mercantile Marine Co.

The battleships Georgia, Maine, Kansas and Kearsarge have been ordered to the League Island navy yard for repairs. They must be ready for their trip to the Pacific coast by Dec. 15.

The electrical course offered at the United States naval academy at Annapolis, Md., has been given an overhauling with the purpose of making it more modern and practical than it has been in the past. Greater attention is to be given to laboratory work and to the actual handling of dynamos, motors, etc., including their assembling, care and operation under practical conditions. Instruction in electrical engineering in the classroom is to be given to the two upper classes only, which have during the first two years completed the preliminary studies in physics and mechanics. Lieut.-Com. W. H. B. Bullard, U. S. N., will be in charge of the course.

Secretary of the Navy Metcalf will refer the matter of making a decision regarding the awards of submarine boat contracts to President Roosevelt. There has been much controversy between the companies interested with regard to a division of the contract, although the examining board had rendered a decision in favor of the Holland type. The Lake company was, however, not discouraged and put up a very good fight to have the contract divided. Secretary Metcalf referred the question to Attorney General Bonaparte, who rendered an opinion to the effect that the division of the award was permissible, and it has now been referred to the president for a solution.

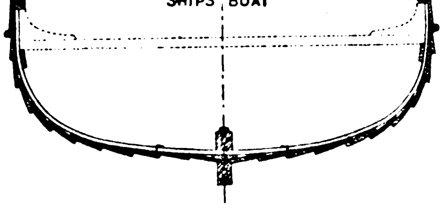
Edward S. Cramp, late of the William Cramp & Sons Ship & Engine Co. of Philadelphia, and George W. Norris, of the banking firm of Edward B. Smith & Co., of No. 511 Chestnut street, Philadelphia, have purchased for $95,000 a piece of property fronting 1,000 ft. on the main harbor, just opposite the Norfolk and Western station, by 1,000 ft. on Pescara creek, Norfolk, with 25 to 30 ft. of water, or enough to accommodate the largest vessel afloat, and will immediately begin the construction of a ship building plant.

STRUCTURAL DEVELOPMENT IN BRITISH MERCHANT SHIPS

BY J. FOSTER-KING

It is necessary to the proper limning of any mental picture of the processes whereby the modern steel merchant ship has developed, to work upon a back-

Fig. 1
SHIPS BOAT



ground formed by the wood ship building methods of the last generation, which still seem to have a hampering effect upon design, and that our ideas should be influenced by the exceeding age of ship building. It is of something more than academic interest to see in Sir George Holmes' interesting book on "Ships Ancient and Modern," a picture of an Egyptian ship built 7,000 years ago, having a length of 100 ft. and overhung ends supported on the principle of the truss girder, and to be told that the Egyptians appear to have built ships out of short thick pieces of hard wood so ingeniously dove-tailed and fastened together that the external shell was apparently capable of providing sufficient strength without the assistance of side framing. As bearing upon the possibility that modern wood building methods may not have developed on the best lines, the Viking ship of old (particulars of which are to be found in Mr. Archer's paper read before the I. N. A. in 1881), with its beautiful form and combination of lightness and strength in hull structure, should also be a feature in the background of the picture. Instead of the wood structure with which we are more or less familiar, in which the transverse members are so closely spaced as to form an almost solid mass fore and aft, and the longitudinal material depends upon the friction of caulked seams for the major portion of its efficiency, the Viking ships of 80 and 100 ft. length were built practically as shown in Fig. 1, which is a section of an ordinary ship's boat, and itself a fine example of the survival of the fittest. There is no change in principle from the known constructive methods of its thousand-year-old predecessor, a principle which probably was then thousands of years old. The whole strength is contained in the external shell—the function of the frames being more constructive than structural—and the hull girder has its bottom and sides formed of planks properly riveted together, in association with small top members which prevent no obstruction to goods or passengers, and are kept apart only by beams. The structural efficiency of the type is proved by its known capacity for overloads of plunder or shipwrecked mariners and for ocean voyages of almost incredible length. The steel ship again is the fruit of a period of growth contemporary with the life-time of one man, a period sufficiently short to satisfy us that it cannot be the fruit of the tree of perfect knowledge, and that present-day requirements should include not only careful cultivation and improvement of tried types, but cautious experiments with new species.

As iron ship building is a product of steam and the iron boiler maker, it was in a sense natural that its earlier application and development should be in connection with steam ships; but, inasmuch as its history has witnessed not only the practical extinction of wood as

Fig. 2.
SAILING SHIP.
200' X 34' 4" X 22' 1½"
1863.

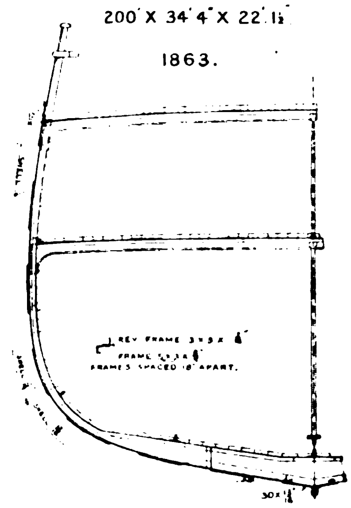
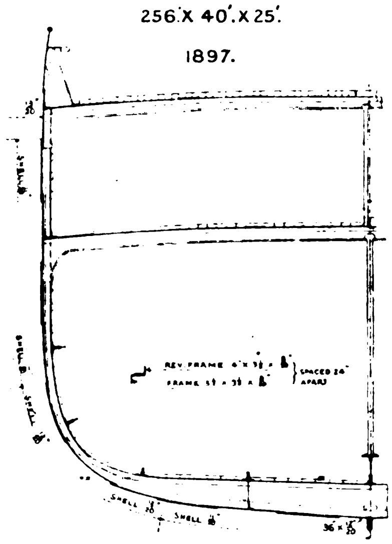


Fig. 3.
SAILING SHIP.
256' X 40' X 25'.
1897.



LARGE TYPE OF SAILING SHIP.
280' X 42' 11" X 26' 0".
1897.

Fig. 4.

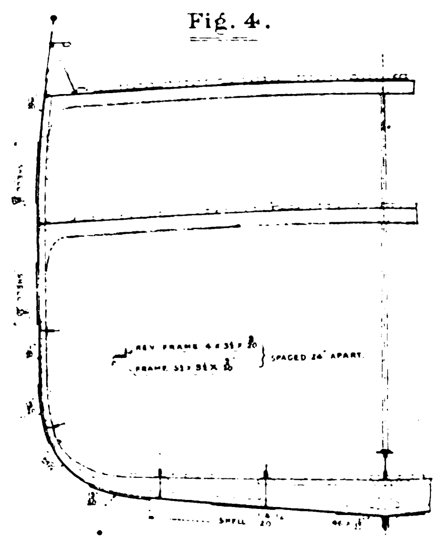
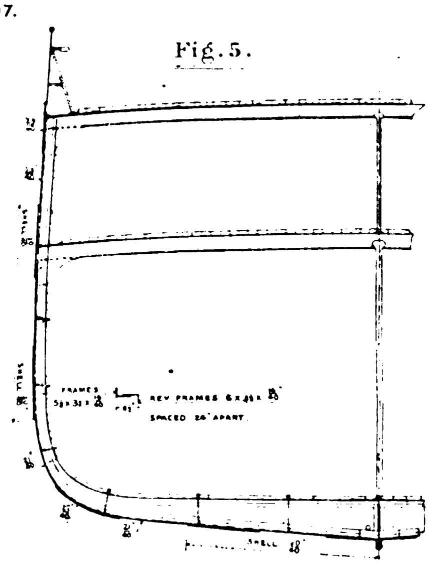


Fig. 5.

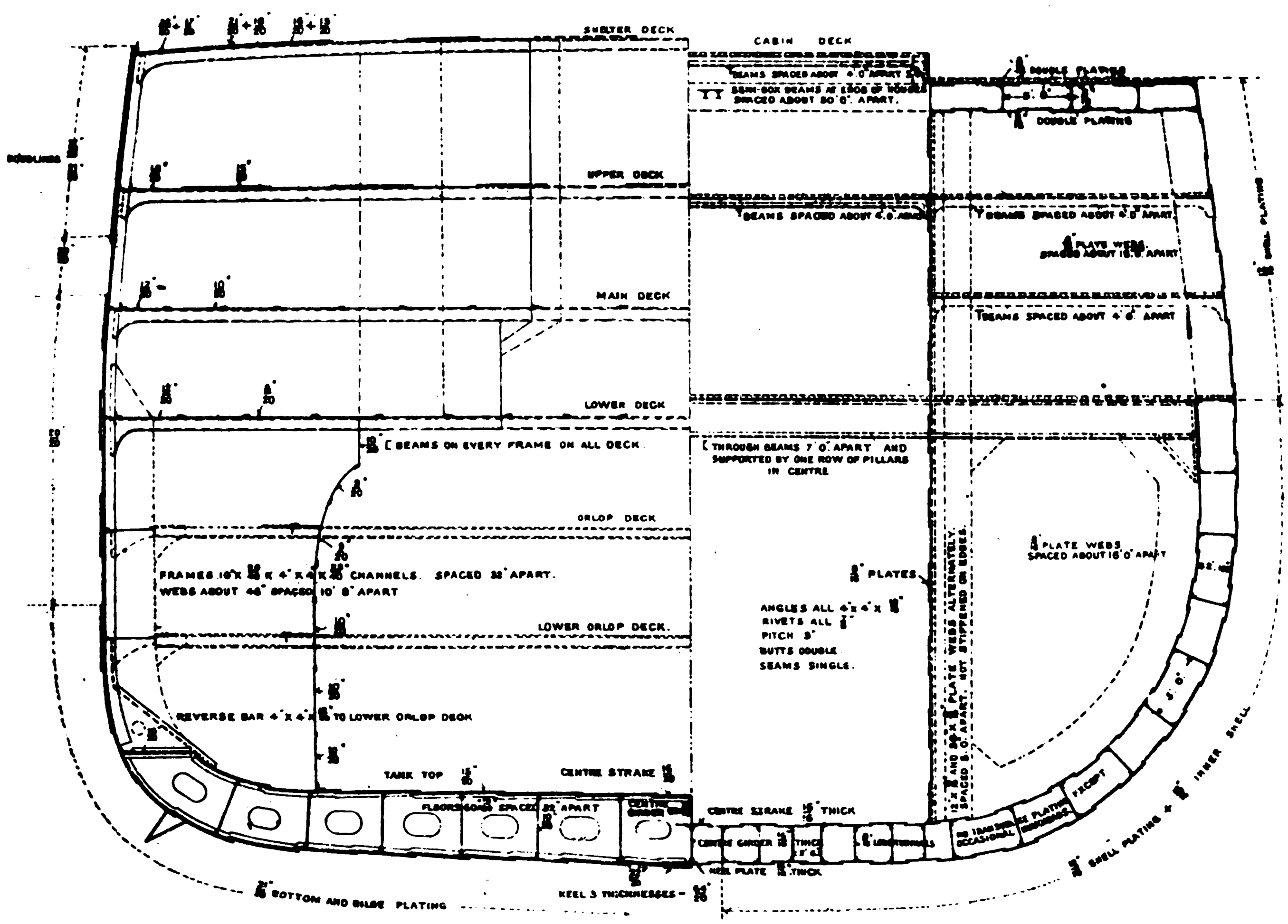


*Read at the Bordeaux International Congress and Institution of Naval Architects.

Fig. 6.

"LUSITANIA". 1907.
760' X 87'. 6" X 60'. TO SHELTER DECK.
STEEL.

"GREAT EASTERN". 1859.
680' X 82'. 2" X 58'. 0".
IRON.



a ship building material for both steam and sailing vessels of any size, but of the application of any material to the construction of the larger class of sailing vessel, it may be regarded as desirable to first refer to the iron and steel sailing ship, as it forms a chapter in the history of structural evolution which is for the moment complete.

Fig. 2 shows the type of structural design which obtained over 40 years ago, when sailers were probably more common in ship yards than steamers, and when the large iron sailer of about 200 ft. length might be said to have taken up the work of the wood ship of similar dimensions, having behind it all the advantages in design derived from 30 years' experience in iron steamship construction. Fig. 3 shows the section of what was still considered a large steel sailing ship when built some 10 years ago, having a length of 256 ft., which shows that, although dimensions and displacement coefficients had increased by about 20 per cent, and scantlings had decreased considerably, there had been no change in principle, except that the second deck stringer and side keelson were connected to the shell. The structural arrangements embody, in different degrees, a shell of great thickness in proportion to length, supported by comparatively shallow frames in association with two complete tiers of beams, and no bulkheads were fitted abaft the collision bulkhead. The whole forms a girder of simple design consisting of bottom, sides, and relatively small top members, and its persistence during so long a period ought to suggest sufficiency. I venture to describe the top members as small, because experience has confirmed me in the faith that wood should not be accepted as an efficient contributory to the strength of iron and steel structures, because the qualities of materials are too far apart. Figs. 4 and 5 show the sailing ship of 280 ft. by 42 ft. 11 in. by 26 ft.,* which may be regarded as the apex of commercial development in British sailing tonnage, if we except the few cases in which the length was increased. Fig. 4 shows the ordinary method of construction under Lloyds rules, which is a continuance on the lines of the previous plans, plus the introduction of increased sizes of keelsons and stringers, supplemented by intercostal shell attachments, together with a complete steel upper deck. Fig. 5 shows the construction of sister vessels built under the rules of the British corporation, where deep frames are fitted. the shell is about 10 per cent lighter than in the corresponding vessels, there is greater complication in the internal structure, but the holds are more free from obstruction. In France and Germany

*All dimensions are molded dimensions.

Fig. 7.

PASSENGER & CARGO STEAMER.
400'.6" X 40'.0" X $\frac{34'.2\frac{1}{2}"}{26'.6"}$

ABOUT 1885.

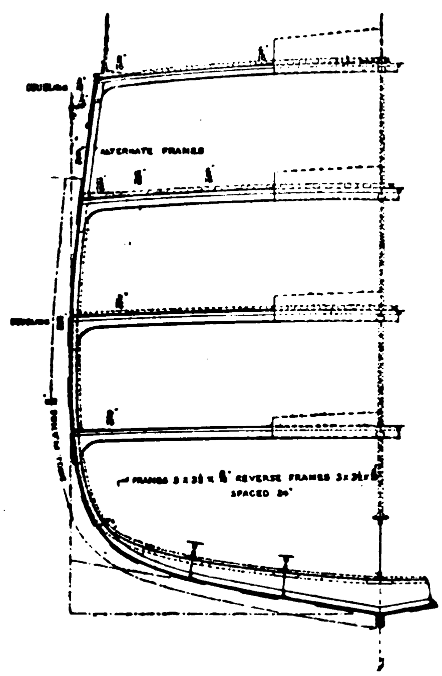


Fig. 8.

S. S. BUENOS AYREAN 1879.
385' x 42'.0" X $\frac{34'.2"}{27'.2"}$

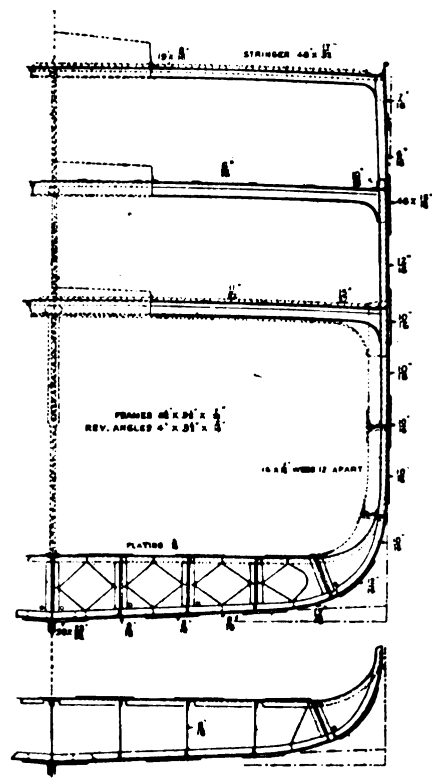


Fig. 9.

S. S. 410' x 42' x 32'.6".
PASSENGER & CARGO STEAMER.
ABOUT 1886.

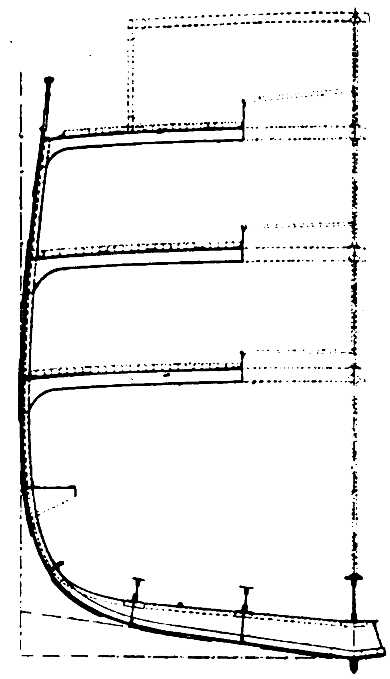


Fig. 10

S. S. 410' x 45' x 32'.6"
EARLY DEEP FRAME DESIGN

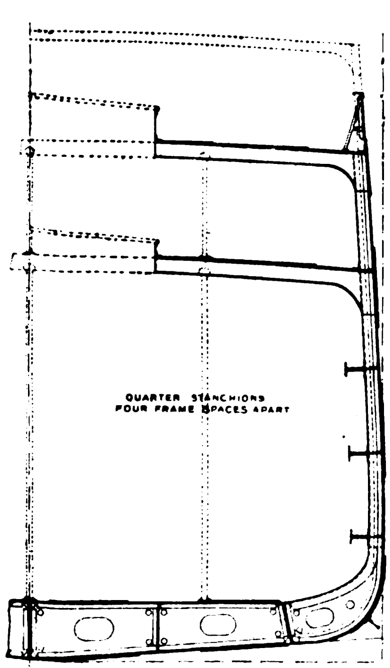


Fig. 11.

PASSENGER & CARGO STEAMER
PRESENT DAY
DIMENSIONS 410' x 52' 6" x 32' 6"

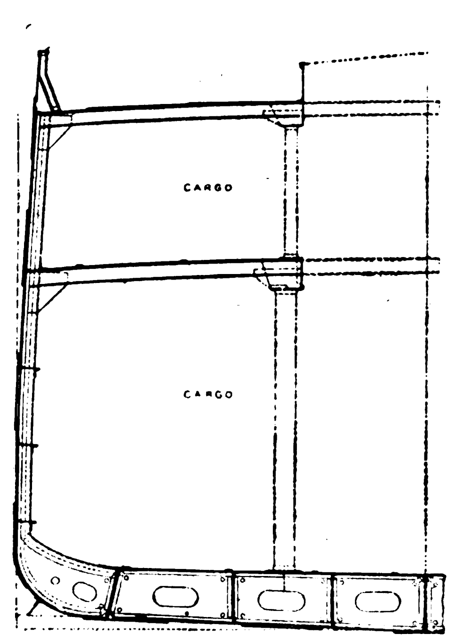
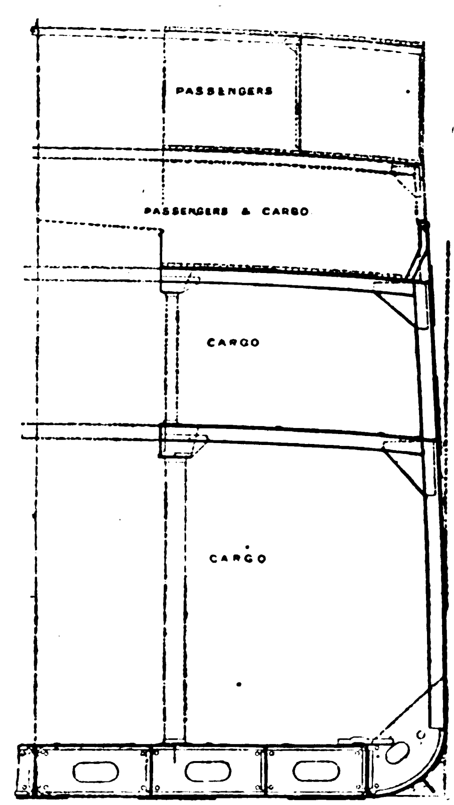


Fig. 12

DIMENSIONS 410' x 52' 6" x 32' 6"



much larger sailing vessels have been built than in Britain, some having lengths which approach 400 ft. Unfortunately I am not in a position to show anything of their design, but should imagine it probable that they have been built much on the same plan as steamers of their size. So far as Britain is concerned, it may be said that progress in sailing-ship construction has been arrested at the stage where increasing size had introduced complexity born of doubt, and if circumstances were to recreate a demand for new sailing ships, history would probably repeat itself, and then construction would commence anew on simpler methods justified by experience with steamers.

The story of the evolution of the very large mail and passenger steamer might justly be said to be epitomized in the papers on the Great Eastern and the two great Cunarders, the Lusitania and Mauretania, which stand on the records of the institution; but before passing to other types, it may be instructive to regard the sections of these vessels as placed side by side in Fig. 6, and to consider their salient features together. The Great Eastern, built in 1859, was 680 ft. by 83 ft. by 58 ft., is stated to have had no sheer, and no close-spaced transverse frames; the transverse members consisted of webs and bulkheads which averaged 16 ft. apart, only a few of them being extended to the outer shell. The tiers of beams below the upper deck were but little better than rafters for flooring, the shell plating was only ¾-in. iron (for which modern practice would call 12-20 steel the equivalent) stiffened by longitudinals 2 ft. 6 in. apart on the bottom, 5 ft. on the bilges and sides, and 7 ft. 6 in. apart on the topsides; there was an inner skin of ½-in. iron (equal to 8-20 steel) extending up to the fourth deck, two longitudinal bulkheads of the same thickness which extended to the full depth of the ship stiffened by plate webs 5 ft. apart. The upper deck was in two layers of two thicknesses of ½-in. plating in combination with longitudinals 5 ft. apart, so that longitudinally she was a single-deck ship, having relatively narrow but very strong top members connected to the lower part of the structure by four films of thin plating, two of which are not stiffened inside the squares of about 16 ft. by 7 ft. 6 in. formed by the deck stringers and webs. The ship was riveted throughout with ⅞-in. rivets, all the plate seams were single riveted, and none of the butts had more than double riveting. There is no gainsaying the

Fig. 13. S. S. 410' x 52' 6" x 33.6 1897

Fig. 14. S.S. 482' x 58' x 42' 6" 1907

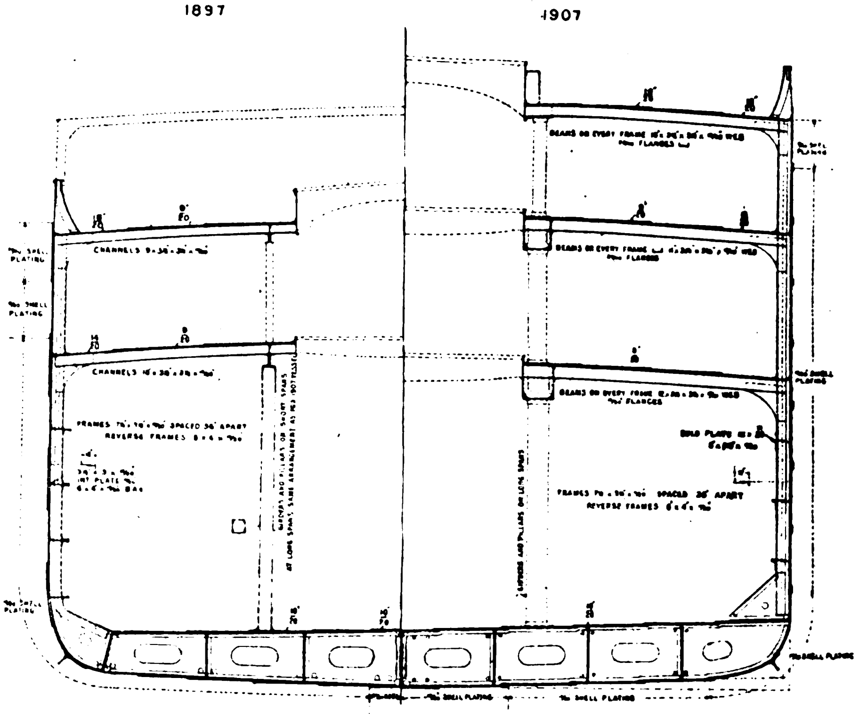


Fig. 15. CARGO STEAMER 280' x 37' x 26' 1885

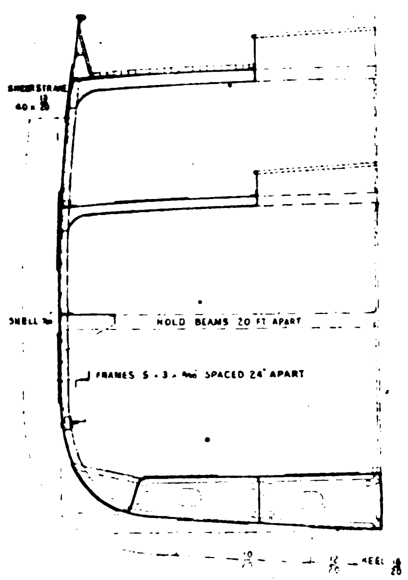


Fig. 16. S S 344' x 45' 10½" x 26' 8" 1898

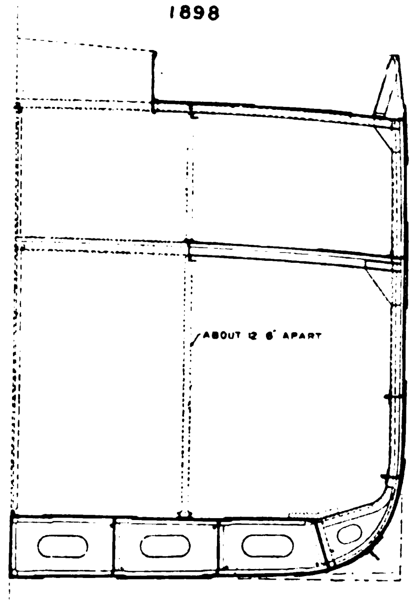


Fig. 17. S S. 312' x 42' 4" x 26' 3" 1896.

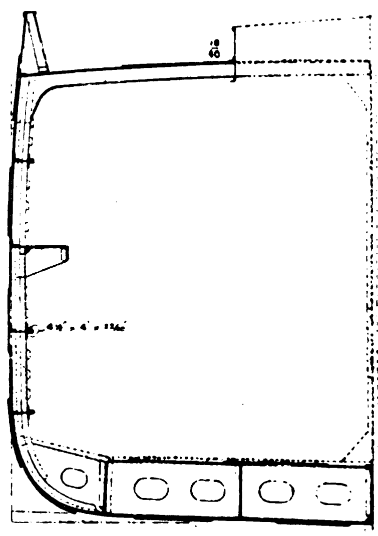


Fig. 18

S. S. 380'. x 52' x 29' 6"

1907

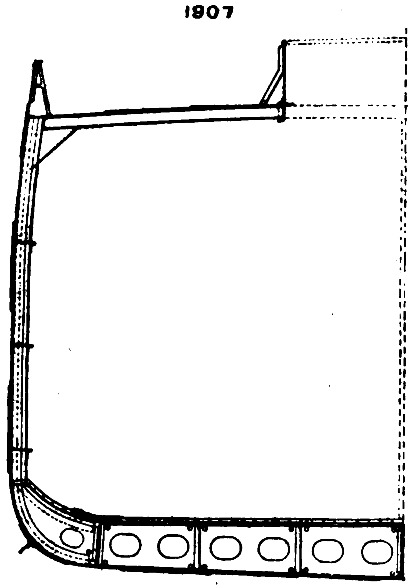


Fig. 19.

AMERICAN LAKE STEAMER

PRESENT DAY. BRITISH DESIGN

252'.0" x 43'.6" x 23'.6"

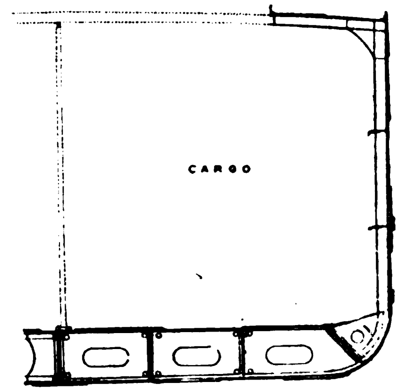


Fig. 20.

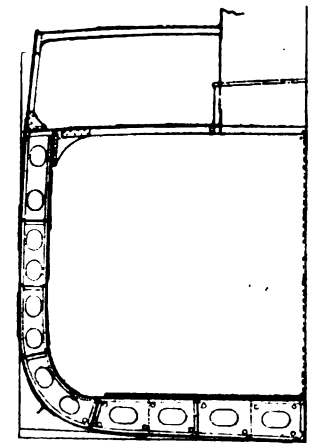
SIDE TANK STEAMER.

MIDSHIP SECTION.

LENGTH B.P. .... 323'.0"

BREADTH EX. .... 47'.0"

DEPTH MOULDED .... 24'.10"



remarkable nature of these facts, and, after discounting the inevitable reduction in their importance by the influence of form, absence of sheer, great depth of hull, and relatively low speed at sea, there seems to be no escape from the conclusion that the lessons to be derived from this monument of successful structural design have not been applied in subsequent practice.

It is the custom to speak of the Great Eastern as being framed longitudinally, but this, of course, is not true in the literal sense of being framed longitudinally and no other way; and, as it is impossible to conceive a metal ship of any size without effective transverse members at sufficiently close intervals to permit of the stresses being transmitted thereto through longitudinal material of reasonable dimensions, it might be well to adopt some other nomenclature to show that such departures from ordinary framing systems merely indicate a widening of the distance between the transverse members.

Fig 22...

S.S. "QUEDA".

1905.

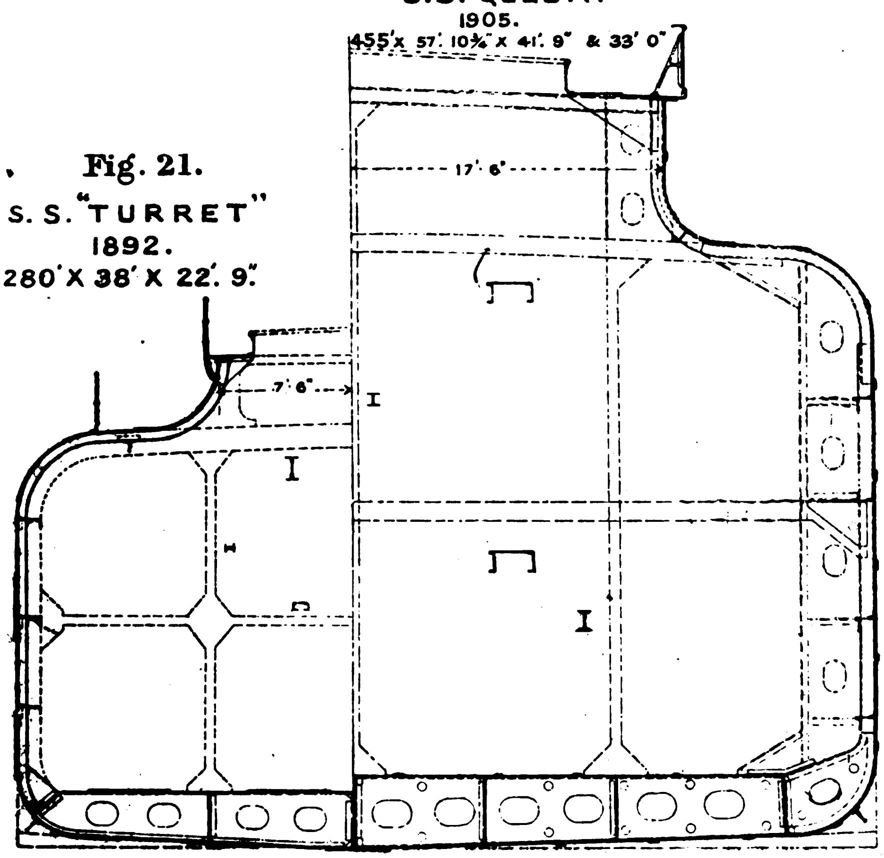
455' x 57'. 10¾" x 41'. 9" & 33' 0"

Fig. 21.

S. S. "TURRET"

1892.

280' X 38' X 22'. 9"

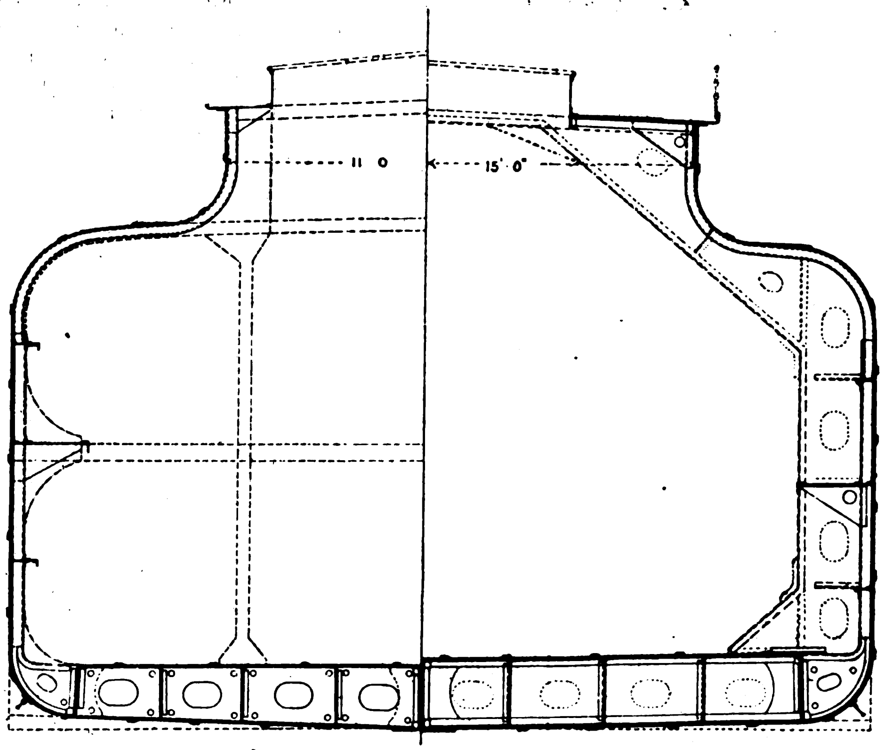


The Cunard steamers are 760 ft. by 87 ft. 6 in. by 60 ft., have sheer, the transverse frames are 32 in. apart reinforced by web frames 10 ft. 8 in. apart; there are four complete steel decks, having beams 32 in. apart; the shell plating is 21-20 to 20-20; there is an inner skin 15-20 thick, extending 8 ft. above the keel, stiffened by 10-20 longitudinals about 6 ft. apart, in addition to the transverse floors 32 in. apart; there are two longitudinal bulkheads $\frac{10-9}{20}$ thick, extending up to the fourth deck, while the top member of the structure consists of two layers of thick plating connected to double topside plating over 2 in. total thickness. The riveting of the seams of shell plating is treble, and of the butts quadruple, with special double straps on the top sides.

The Lusitania and Mauretania represent the latest and greatest development of a modern type, which, owing probably to the commercial failure of the older vessel, has not at any time, been appreciably influenced by the example of the Great Eastern's structure, a type which probably shows less variation, less originality in conception, and greater excellence in execution than any other, probably because cost is not usually a paramount consideration, and it is a necessity of design that it be provided with as many decks as possible, consequently the modern tradition that the decks

Fig. 23.
S.S. 340' X 45'.6" X 27'.3" & 34'.3"
1896.

Fig. 24.
S.S. 350' X 50' X 26'.3" & 33'.6"
1905.



which are fitted under the upper deck are structural necessities has remained undisturbed in practice.

The large iron steamer for passengers and cargo even forty years ago was quite commonly of about 400 ft. in length, although some seventy years ago the largest iron steamer afloat was only 185 ft. long, and, as was to be expected, the design of the earlier iron structures was closely allied to that of contemporary wood ships. The frame spacing rarely exceeded 18 in., the bilge plating was often 25 per cent heavier, while the sides were usually thinner than the bottom plating. Fig. 7 (Plate I.) shows an example of the ordinary type of large passenger and cargo steamer of some thirty years ago, many of which are still running, where the weather deck had light stringer and tie plates in association with light topside plating and a narrow sheer strake doubling, there were four tiers of beams, the second and third of which were plated, and the hold space was filled with great keelsons standing inside the framing. So far as I know, all the existing vessels of this type had the weather deck completely plated not long after construction.

Fig. 8 shows the Buenos Ayrean, built by Messrs. Denny in 1879 for the Allan line, the first steel steamer for Transatlantic service—a vessel which marks an epoch, although it only shows a structural design similar in principle to the previous case, advanced to the extent of having only three decks and web frames in the hold in association with a double bottom, and a general reduction in scantlings on account of the superior material. The double bottom construction on this section, with its excessive longitudinal material, cost, and difficulty of construction, provokes a reference to the crooked way in which such developments always seem to work; the first double bottom was simply a series of iron tanks laid on top of the ordinary floors, the next and obvious step was to rivet girders on top of the floors, plate them over, and fit watertight chocks round the frames—the Macintyre tank—then came the common adoption of the various designs, such as that on the Buenos Ayrean, where the double bottom was made part of the structural design; and by the time this stage had been reached everyone seemed to have forgotten that in the sizes of ships commonly built a double bottom provides greater bottom strength than is needed for the structure as a whole, or than is provided with the ordinary floor construction.

It cannot be said that the introduction of steel revolutionized shipbuilding, although it pushed progress faster, nor that the manufacturer has been ahead of the consumer, although there have been great developments since the days of the Buenos Ayrean in the number of sections and sizes of material available. In fact, it was not until the standards committee took up the work two years ago that any attempt was made in Britain to systematize the form of steel sections, or to obtain reasonable proportions of web, flange, etc., to depth of sec-

Fig. 25.
S.S. 350'X50' X 25'.3" & 32.3.
1907.

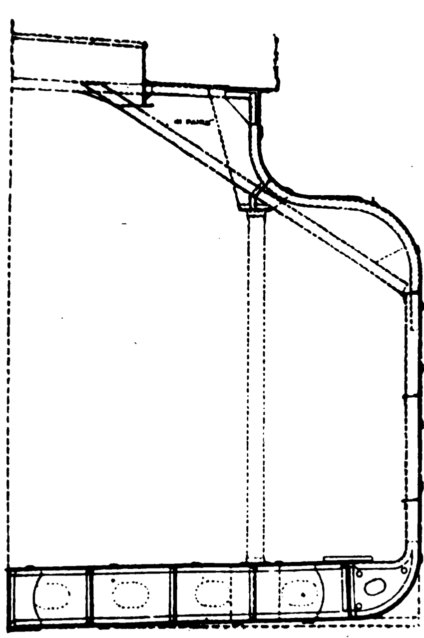
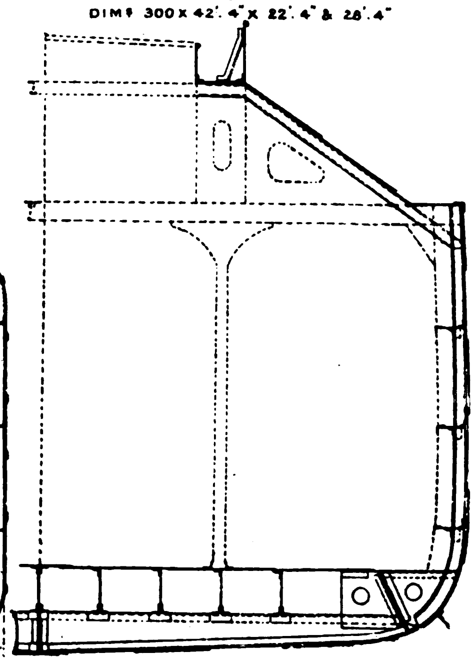


Fig. 26.
PRIESTMANS SELF TRIMMER.
S.S. "UNIVERSE".
1898.
DIMS 300 X 42'.4" X 22'.4" & 28'.4"



DIXON & HARROWAY DESIGN.

Fig. 28.

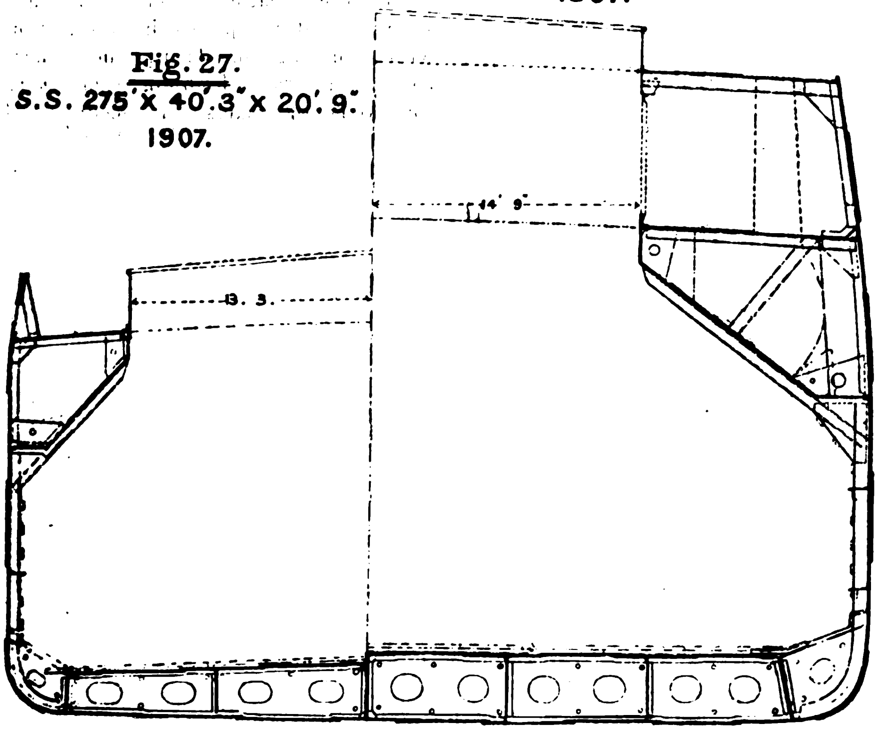
S.S. 390'.0 x 55'.9" x 26'.6" & 35'.0".

1907.

Fig. 27.

S.S. 275' x 40'.3" x 20'.9".

1907.



tion. It is to be hoped that standardization will not spell delay in further improvement in section design and development of sizes.

Fig. 9 shows a healthier type of design of structure, which was contemporary with those just considered, where the proportions of depth of ship to breadth are improved and the weather deck has become the strong deck, although three tiers of beams and numerous internal obstructions in the holds are still considered necessary. Without elaborating upon the intermediate stages, Fig. 10 shows the advanced design of some fifteen years ago, where the third tier of beams has been displaced, the frames increased in depth, and ornamented with H girders, while the additional beam support due to increased breadth was provided in the form of a complete center row and two rows of quarter stanchions on alternate beams, in association with a uniform size of beam. Fig. 11 shows the practical recognition of the inutility of heavy side stringers, which, after minor intermediate phases, became universal within the last few years, as well as the deck girders in association with wide-spaced quarter pillars, which by the same time had advanced into common practice. Fig. 12 shows the very recent and what may be the final stage in the evolution of side stringers, their total disappearance from the three midship compartments; in lieu thereof the deep frames are increased in depth and width of flange, the bracket floors and beam knees increased in size beyond the normal, the frame riveting closed up, and the shell plating increased in thickness. There is no rise of floor in this particular design, so that the double bottom is lowered without reducing the capacity or depth at margin plate, and in the midship portion of the hull the double effect is obtained of reducing cost of manipulation through the reduction in number of parts as well as the fact of all the frameworks, with the exception of the small bar at the turn of bilge, being handled cold; and of providing increases in the general longitudinal and transverse strength and stiffness on no more weight of material, through the translation of the weight of the side stringers into direct increases in the shell and frames. At the ends of the vessel, where the frames are beveled, the ordinary method of construction in association with side stringers

Fig. 29.

BIRRELL'S DESIGN.

305 x 46'.9" x 24'.0" & 30'.3".

1907.

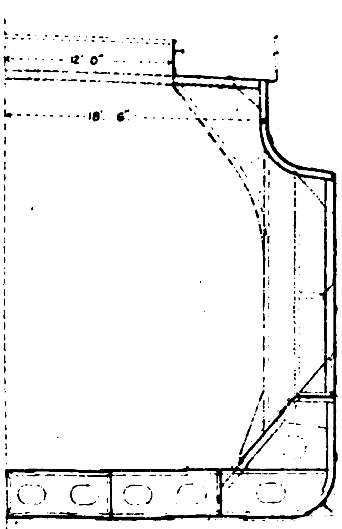


Fig. 30.

MIDSHIP SECTION.

ROPNER'S PATENT IMPROVED TRUNK STEAMER.

DIMENSIONS. 350'.0" x 50'.0" x 25'.3" & 33'.9".

1907.

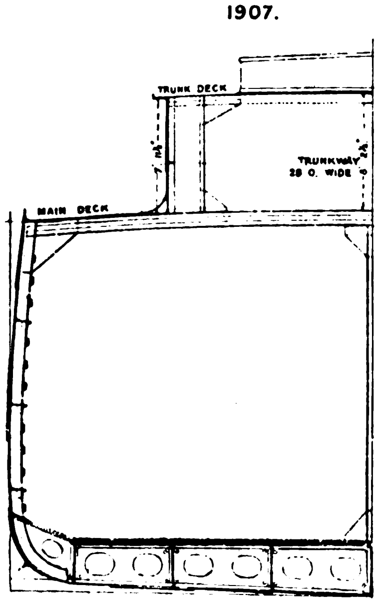
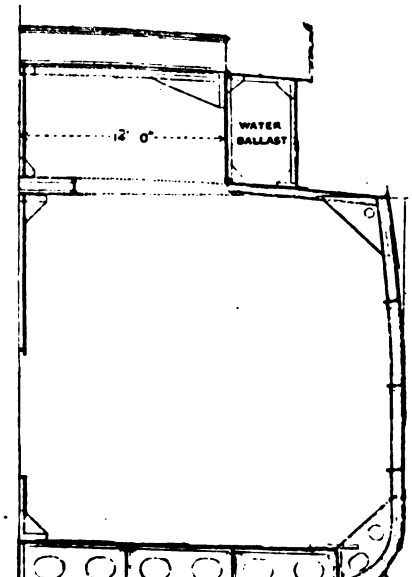


Fig. 31.

MIDSHIP SECTION.

360' x 52'.6" x 27'.3" & 35'.3.

1907.



is adopted; but development in the direction of simplicity is probable in this neighborhood also. In this case the deck support is obtained by two girders in association with tubes about 32 ft. apart, and a simple but modern improvement in the attachment of the bracket floors to the margin plate is indicated. The type of design shown in Fig. 11 has gone on gradually from size to size, until it has reached dimensions so great as 490 ft. by 57 ft. 6 in. by 35 ft. 3 in., nor does there appear to be any reason against further extension, although it seems but yesterday that the possibility of having less than four decks in a ship of this depth would scarcely have been considered.

It would be wrong to leave this branch of design without something more than a passing reference to the effect thereon of the individuality of the firm of Mr. Alfred Holt, of Liverpool. Mr. Wortley, of that firm, read a paper on the subject of their special design of steamer before this Institution in 1900, and by the courtesy of that gentleman I am now enabled to show on Figs. 13 and 14 the first, compared with the latest of the type built during the past year. It will be seen that the erections on the earlier design have been replaced in the latter by a complete shelter deck, the weather deck being made the strength deck; the dimensions of the vessels have increased considerably, but the shell plating remains 15-20 in association with 3 ft. frame spacing. The double bottom now runs straight out to the side, so that the upper frames amidships do not require to be furnaced, the typical arrangement of deck girders and wide-spaced stanchions is retained, and the deep tanks are still successfully constructed without central divisions. Mr. Wortley has been kind enough to permit the publication of the principal scantlings of these ships, so that it is an easy matter to appreciate a successful development on broader lines than ordinary; but it is not so easy to judge of the great benefit to shipowning and building which has resulted from the initiative of Mr. Wortley and his firm, nor can I too liberally acknowledge its educative effect upon myself.

The cargo steamer seems to me to be the most important species of the genus ship, not only because it is numerically the largest, but because it shows the greatest number of variations, and the greatest activity in developing these into distinct species. The ordinary large cargo steamer of thirty years ago, as exemplified in Fig. 15, was but a modification in dimensions of the contemporary passenger and cargo type just considered, ranging in length from 260 ft. to 280 ft., having two tiers of beams, a tier of wide-spaced hold beams, and, quite commonly, a double bottom. For smaller vessels the raised quarter-deck or well-deck type, was practically supreme; but it seems unnecessary to deal with them separately, as they presented few special features in construction which have not since been embodied in the now paramount type having continuous decks. The raised quarter-deck has been of evolutionary value from the fact that the demand for the omission of complete tiers of beams in way of the quarterdeck had to be faced and met almost from the beginning; so that the introduction of web frames, as an efficient substitute for a third tier of beams in a three-deck, or a second tier in a two-deck ship, is now a matter of quite ancient history. The web-frame ship was an improvement in design for bulk carriers, but the broken stowage for other trades created a demand which led to the deep-frame system being introduced, I believe, by Messrs. Stephen, of Linthouse, about 1887; that is, each frame was made stiff enough and strong enough for the longer spans caused by the omission of tiers of beams. These systems have been grafted upon one which gradually increased the sizes of ordinary frames in rough proportion to the midship dimensions of the ship, and introduced additional tiers of beams at arbitrary depths, so that anomalies are not unknown in practice. The development of the deep frame and side stringer has already been illustrated, so that we may jump to the developments in general design of the past fifteen years, and refer to Fig. 16, which shows the beginning of wider spacing of stanchions, and how the exigencies of bulk carrying trades led to the omission of the wood deck from the second deck level, an omission of valueless material which seems to have been at first generally, although not universally, regarded as one having such structural importance as demanded either compensation or freeboard penalty. That a wood second deck, cut by bulkheads and non-existent in the machinery space, could ever have been regarded as an effective element in the structure of a steel ship is one of those mysteries which appear to attend all evolutions.

The steamship Lincluden, 312 ft. by 42 ft. 4 in. by 26 ft. 3 in. (Fig. 17, Plate II.), so far as I know the first real single-deck ship of this depth, or near it, was built by Messrs. Furness, Withy & Co., of West Hartlepool, in 1896, and was considered to be a radical, if not dangerous, departure; but circumstances have more than justified the design, and this ship was the forerunner of a type which is now becoming comparatively common. A number of relatively large vessels have been built having wide-spaced strong beams in association with wide stringer plates at mid depth, but the largest vessels of ordinary form of which I know anything, in which reliance is placed solely upon deep framing, unsupported by beams of any kind below the upper deck, have depths of 28 ft. 6 in. to 29 ft. 6 in. (see Fig. 18). The range of development in this type is shown by comparison of Fig. 18 with Fig. 19, a single-deck steamer, 252 ft. by 43 ft. 6 in. by 23 ft. 6 in., of which a number have been built for service on the American lakes, and whose depth corresponds with the least for which three tiers of beams used to be the standard. We have already reached a close approximation in design to an open boat with a portable deck, and, if trade requirements demand it, we are yet far from having reached any limitation upon the dimensions of this type based on practical considerations. The evolution of the single-deck steamer from the three-deck type has been on clear, well-defined lines, but recent activity in designing new methods of construction and types of ship intended to solve the problem of combining large capacity and large deadweight on limited draught, with ample water ballast capacity, unbroken stowage, absence of hand trimming for bulk cargoes, and simplicity of construction, has produced designs which are such variations from the parent ship as to form distinct species, and which have already had, in some cases, quite an evolutionary history. For example, Fig. 20 (Plate III.) shows Mr. McGlashan's ship, in which there is no change in external form, but where, by the simple expedient of adopting two skins of plating, it is possible, not only to carry a very large quantity of water ballast, having a higher center of gravity than the normal, but to secure such great transverse and longitudinal strength from material disposed of in the best position so as to give the power of practically indefinite expansion in ship dimensions.

Then the "Doxford" turret shows

features which make it perhaps the most interesting of these modern designs. The steamship Turret, 280 ft. by 38 ft. by 22 ft. 9 in., and 27 ft. 3 in. to turret deck (Fig. 21), built in 1893, and the first vessel of the type, presents the essential features which are now familiar; the turret is an integral part of the hull, and the turret deck stringer forms the top member of the girder. the turret base is rounded to permit free flow for bulk cargo, and the junction of the harbor deck with the side is rounded to avoid waste space or trimming charges. The principle of the transverse structure in the Turret, the outstanding feature of which is the open framework of strong stanchions and hold beams at comparatively wide intervals, remained unchanged until recently, the larger number of turret vessels built up to that time being, as shown on Fig. 22, vessels, 340 ft. by 45 ft. 6 in. by 27 ft. 3 in., and 34 ft. 3 in. to the turret deck, having modified webs in association with the built beams and stanchions. The largest development on these lines is to be found in (Fig. 23) three steamers for the B. I. Co., 455 ft. by 58 ft. by 33 ft., and 41 ft. 9 in. to the turret deck. Longitudinally, these vessels are pure single-deck ships in so far that all the material is contained on the outside walls, while the turret design of transverse framework is adhered to, plus the addition of large webs between the hold beams. These vessels each carry over 2,000 tons of water in a deep midship tank 36 ft. long, of which the turret deck is the crown, and the base of which is subject to a pressure of considerably over a ton per square foot, while the central wash division stops at the level of the broadside stringer. About two years ago a novel principle in construction was introduced by Messrs. Doxford, as shown in Fig. 24, where the ship is kept in shape by wide web frames at the hatchway ends arranged continuously round the skin of the ship, of such form and strength and having such strong attachments to the double bottom (which is increased in depth) that the complete framework should be incapable of deflection in any direction, and permits of stanchions and beams below the turret deck being entirely omitted. At the present time Messrs. Doxford are building to the design shown in Fig. 25, where, by fitting large tube stanchions at the hatchway ends under the stiff turret sides, in association with diagonal ties in pairs, an interesting combination of material has been evolved.

Fig. 26 (Plate III.) shows the Priestman self-trimmer Universe, in which the top sides are sloped from the upper or turret deck level to a narrow platform at the harbor deck, and the internal structure is of the wide-spaced open framework type. It is of interest to note the double-bottom construction and absence of intercostals to the bottom shell.

Messrs. Sir Raylton Dixon have built a number of vessels which are known as "Harroway & Dixon's Patent," which there are sloping ballast tanks in the corners of the top sides as shown in Fig. 27, and where the stiffness and strength of top sides obtained by this form of construction, permit of very wide hatchways. As the vessels are so designed that it is practically impossible to conceive of deflection in the corner tanks between the bulkheads, the hatchways can be made practically the whole length of each hold, and the builders are enabled to dispense with stanchions and beams in the holds. The largest vessel yet built on this plan is 390 ft. by 55 ft. 9 in. by 26 ft. 6 in. and 35 ft. (see Fig. 28), where a shelter deck is fitted above the upper deck, and with this, as with the original single-deck design, practically unlimited expansion in dimensions of ships should be possible.

Fig. 29 shows a steamer 305 ft. by 46 ft. 9 in. by 24 ft., being built by the Sunderland Shipbuilding Co., to the design of Mr. Henry Burrell, which embodies several interesting features; the double bottom is sloped up the sides of the vessel so as to form a self-trimming trough for coal or grain, and the upper works are arranged so as to give free flow for bulk cargo; while the sides, trunk way, and decks are so supported by what, for want of a better name, may be called cantilever webs, and by comparatively closely spaced bulkheads, that stanchions are unnecessary. The construction is simplified in this case by adopting a spacing of 32 in. for the frames.

Fig. 30 shows the "Ropner" trunk, in which the ship is of ordinary deep frame construction up to the harbor deck, which is kept apart by strong beams at hatchway ends, etc., while the trunk is supported by webs, cross plating, and strong built center stanchions in association therewith. In the earlier vessels of the type, built stanchions were fitted under the trunk sides at comparatively close intervals, and the trunk was a comparatively light erection, experience has shown the former to be unnecessary, and the desirability of re-arranging the material so as to make the trunk the effective top member of the girder. A remarkable development of this design is shown in Fig. 31, where the trunk sides are doubled, and spaces thus formed carry water ballast; the upper structure is supported by large webs, the engines are placed aft, there are two hatchways, each over 100 ft. in length, and the hold is in one length from collision bulkhead to machinery space. It must be admitted that the design is abnormal, and may be taken as to some extent experimental; but its conception is indicative of the freedom which has come over the spirit of shipbuilders during recent years.

If attacked solely from the point of view of economy and efficiency of design and as a problem in engineering, unhampered by preconceived ideas of construction and trade requirements, it seems to be obvious that the natural design of a ship-shaped girder would be one which would have the material disposed entirely on the circumscribing walls, but misconceptions of true principles in design are unavoidable legacies from previous constructive methods. The influences which have caused persistence in bad disposition of longitudinal material are not easily understood, perhaps they follow from the influence of wood shipbuilding methods, while the retention of the name "Main," as applied to a deck which was not the top deck, may have had the effect due to suggestion. We have certainly grown up amid the conception that numerous tiers of beams are natural and that their omission demands compensation, instead of what seems to be the sound idea exemplified by Messrs. Brunel and Scott Russell half a century ago, that the ideal structure would have the longitudinal material massed on the upper deck, bottom, and sides; the transverse members would be of the simplest form and fewest number possible, with their contributory elements as far apart as the thickness of plating would permit; while additional tiers of beams or layers of plating would be regarded as unscientific and to be fitted only under compulsion of trade conditions, but that, when fitted, the best use had to be made of them as factors in the structural equation, in order to minimize what must necessarily be wasteful in weight, just as is the central core of a shaft or any other massing of material in the wrong place.

It appears to me that a study of the diagrams will show that the tend-

ency of all types of development, with the exception of the large mail and passenger steamer, has been towards reduction in number of parts, economy of labor, rather than of weight, to a probably unconscious realization of the principles of design which I have ventured to put forward as the best; and particularly in the case of bulk carriers to the closest possible approximation to an open boat—a design which seems to be not only the child of the ages, but the father of the ideal design for such vessels.

THE WORK IN COAST SHIP YARDS

Crawford & Reid, Tacoma, Wash., recently launched a tug for Capt. Arthur Weston, of Olympia, Wash.

The William E. Woodall Co., Baltimore, Md., is rebuilding the steamer Louise, owned by J. J. Callahan, Newport News, Va.

A fire recently at Brewer's Ship Yard, at Mariner's Harbor, Staten Island, destroyed one of the frame buildings.

Tarr & James, Essex, Mass., launched a fishing schooner for Cunningham & Thompson Sept. 24, she being christened Arethusa.

Frank S. Bowker & Son, Phippsburg, Me., will have the three-masted schooner Horace M. Bickford ready for launching about Oct. 15.

The Fore River Ship Building Co., Quincy, Mass., has completed the work of fitting new propellers to the Morgan Line steamer Creole.

Cramp & Sons Ship & Engine Building Co., Philadelphia, has lengthened the steamship Allianca, owned by the Panama Railroad Co., 36 ft.

John Weaver & Son, Orange, Tex., have the barge which they are building for the Hamburg-American Steamship Co. almost ready for launching.

The dredge Bristol, recently completed at Green's yard, Chelsea, Mass., has been delivered to her owner, the J. S. Packard Dredging Co., Providence, R. I.

The Moore & Scott Iron Works, San Francisco, Cal., have completed the repairs to the army transport Sheridan, the cost of which aggregated $12,500.

The Maryland Steel Co., Sparrows Point, Md., has completed the dredge Culebera for the Isthmian canal commission and she is now on her way to the isthmus.

The Marine Slip at Darmouth, N. S., has the Norwegian coal carrier Universe on the ways for repairs to injuries sustained from her stranding in July at White Head.

P. Delaney & Co., Newburg, N. Y., recently installed one of their boilers on board the side wheel steamer William Fletcher, owned by the New York Harbor Towboat Co.

The new revenue cutter Androscoggin, built by the Shooter Island Ship Yard, Shooter Island, N. Y., has been sent to Wilmington, Del., to have her boilers installed.

The Fore River Ship Building Co., Quincy, Mass., has the contract for repairing the Metropolitan Steamship line steamer Herman Winter, which was recently in a collision.

The Harlan & Hollingsworth Corp., Wilmington, Del., has delivered the ferry boat Nassau to the city of New York. She is intended for use on the Thirty-ninth street ferry route.

Joseph McGill, of Shelburne, Nova Scotia, launched a 70-ton schooner for J. H. Longmire & Sons, of Bridgetown, N. S., Oct. 1. She will ply between Bridgetown and St. Johns, N. B.

John H. Dialogue & Son, Camden, N. J., launched the tug Goliath, building for the Ship Owners' & Merchants' Tugboat Co., of San Francisco, last month. The Goliath is 136 ft. long.

The Harlan & Hollingsworth Corp., Wilmington, Del., recently had the ice breaker John Weaver, owned by the city of Philadelphia, at its plant to remedy a defect in her steering gear.

The Harbor Commission of National City, Cal., has granted the petition of Mr. C. A. Meyer for locating a ship yard there, which will concern itself chiefly with the building of metal boats.

Booz Bros., Baltimore, Md., are rebuilding the tug Gerry, which was sunk and raised by the Merritt & Chapman Wrecking Co. She is owned by the Standard Dredging Co., Wilmington, Del.

William E. Woodall & Co., Baltimore, Md., launched a covered lighter last month for the Chespeake Steamship Co. for use at Norfolk, Va. The vessel is 125 ft. long, 28 ft. beam and 8½ ft. deep.

Percy & Small, Bath, Me., are busily engaged upon the construction of two new schooners, one a five-master and one with six sticks. The former is expected to be ready for launching in about two months.

I. L. Snow & Co., Rockland, Me., have begun work on a new three-masted schooner for the general coasting trade, which is to be on the lines of the Helvetia and Wawenock, recently built at the same yard.

The Union Iron Works, San Francisco, Cal., has recently been engaged in repairing the Pacific Coast Steamship Co.'s steamers Senator and Queen, over $150,000 worth of work being done on each of them.

The Harlan & Hollingsworth Corp., Wilmington, Del., launched the car float known as No. 3 for the Jersey Central Railroad last week, and it has since been towed to New York. The float has a capacity of 28 cars.

The Portland Ship Building Co., Portland, Ore., launched the steamer Bailey Gatzert for the Regulator line recently. This vessel is a wooden passenger steamer of the stern wheel type and has an excursion capacity of 625 passengers.

The Moran Co., Seattle, Wash., has the contract for repairing the steamer State of California, owned by the Pacific Coast Steamship Co., the repairs consisting of the installation of a new set of boilers at a cost of about $115,000.

The Spedden Ship Building Co., Baltimore, recently had the tug Robert H. Smith, sold by them to the Isthmian canal commission, hauled out on the ways for the purpose of fitting a new propeller. Some changes were also made to her deckhouse.

The Robert Palmer & Son Ship Building & Marine Railway Co, Noank, Conn., has launched the ferry boat Perth Amboy for the B. & O. Railroad, for use at Tottenville, S. I., and her machinery was installed by the W. & A. Fletcher Co., Hoboken, N. J.

The Maryland Steel Co., Sparrows Point, Md., has been awarded contract by H. F. Hodges, general purchasing agent of the Isthmian canal commission for the construction of three steel barges of 4,000 tons each, to be delivered in 120 days, the price being $59,495.

The Mathews Ship Building Co., Hoquiam, Wash., launched the steam schooner Saginaw, built for the Hart-

wood Lumber Co., of Aberdeen, Wash., Sept. 25. The Saginaw is 225 ft. long, 39 ft. beam and 14 ft. 6 in. depth of hold. The contract price was $105,000.

The keel for the steam schooner for Ira J. Harmon, of San Francisco, was laid at the yard of John W. Dickie & Son at Raymond, Wash., recently. The vessel is 205 ft. long, 49 ft. beam and 18 ft. draught. She will have a carrying capacity of 1,000,000 ft. of lumber.

The South Marine Railway at Rockland, Me., has the schooner Mary Curtis on the ways for repairs, consequent upon her having recently gone ashore at the mouth of York Narrows, where she sustained serious damages. She is owned by George L. Currie, Richmond, Va.

The John N. Robins Co., Erie Basin, N. Y., has the contract for making extensive alterations to the 7-masted schooner Thomas W. Lawson, the largest vessel of her kind in the world. A system of steel bulkheads is being installed which will cost about $70,000.

The Moore & Scott Iron Works, San Francisco, have been awarded the contract for repairing and overhauling the Mexican steamer St. Denis, the work comprising the installation of oil-burning apparatus and complete new floors and frames under the engines and boilers.

The Moran Co., of Seattle, Wash., announce that they will hereafter maintain their works upon an open shop basis. The decision was brought about by a sympathetic strike of machinists at the yard although they were receiving more than the machinists' union is striking for.

The William Skinner Ship Building & Dry Dock Co., Baltimore, Md., recently removed a broken propeller, drew the tail-end shaft and placed a new propeller on the Hamburg-American line steamer Macedonia, all in the space of 22 hours, the vessel being in dry dock but 24 hours.

The Newport News Ship Building & Dry Dock Co., Newport News, Va., has completed the repairs to the former lake steamer William Chisholm and she is now in the coal-carrying trade to Boston, towing the barge Lancaster. She is owned by the Seaboard Transportation Co.

The Merrill-Stevens Co., Jacksonville, Fla., have completed repairs to the Clyde line's St. Johns river steamer Frederick de Barry and the United States dredge Key West has also been thoroughly overhauled before proceeding to Tampa, Fla., where she is to be engaged in dredging for several months.

William E. Woodall & Co., Baltimore, Md., are building a large six-pocket mud scow for stock, which it is anticipated will be sold before completion as have all of the same type built at the yard. The scow is to be 125 ft. long, 36 ft. beam and 12 ft. deep, with a capacity for about 1,000 cubic yards of excavated matter.

The Kelley-Spear Co., Bath, Me., launched the barge Sydney, building for the New York, Ontario & Western Railway Co., Sept. 21. The dimensions of the Sydney are as follows: Length, 180.9 ft.; beam, 35.1 ft., and depth 14.1 ft. This is the third vessel of this type built at the yard for the same owners during the summer.

What is said to be the most perfectly designed power boat for lobster fishing in the country was launched recently by her builders and owners, Fred B. Higgins & Co., Boothbay Harbor, Me. The vessel, which was christened Elk, is 38 ft. long, 10 ft. beam and 6 ft. deep. She is equipped with a 13-H. P. gasoline engine.

The East End Ship Yard at Portland, Me., was the scene, Sept. 18, of the launching of the four-masted schooner Victory, owned by the New England Navigation Co., of Portland, the dimensions of which are as follows: Length over all, 205 ft.; keel, 170 ft.; beam 37½ ft.; depth of hold, 13½ ft. The Victory is the first four-master to be built at Portland.

The sternwheel steamer S. G. Simpson, building for the Shelton Transportation Co., Shelton, Wash., was launched at the yard of Crawford & Reid, Old Town, Wash., Aug. 19. The vessel is to ply in the passenger service between Shelton and Olympia and is 140 ft. in length over all, 26 ft. beam and 6 ft. deep. She will accommodate about 300 passengers.

The steamer which the Newport News Shipbuilding & Dry Dock Co., Newport News, Va., is constructing for the Matson Navigation Co., San Francisco, Cal., is progressing rapidly and will be ready for operation in the spring. This steamer will carry on a freight and passenger service between San Francisco and Honolulu.

The steel steam lighter New England was launched recently by the Fore River Ship Building Co., Quincy, Mass., for the New England Steamship Co. The lighter, which is intended for service in Boston Harbor, is of the following dimensions: Length over all, 130 ft.; extreme beam, 31 ft. 6 in.; depth molded, 13 ft. 6 in., and gross tonnage 450 tons.

The steam schooner Gray's Harbor, building at the Lindstrom yard at Aberdeen, Wash., was launched Aug. 25. The vessel was ordered by Beadle Bros., of San Francisco, but was sold when partially completed to Sudden & Christensen, also of San Francisco. The Gray's Harbor is 187 ft. long, 38 ft. beam and 33 ft. depth of hold. Her machinery will be installed at San Francisco.

The New England Ship Building Co., Bath, Me., has been awarded contract for the construction of a four-masted schooner for the Benedict-Manson Marine Co., of New Haven, Conn., to be a duplicate of the Bertha L. Downes, building at this yard for the same firm. The dimensions are as follows: Keel 165 ft.; beam 37 ft.; depth 13.5. The New England company now has three vessels in hand, the third being to the order of Capt. James Hawley of Bath, it being a four-masted schooner.

The Fore River Ship Building Co. has concluded the repairs on the tug boat Mercury of the Boston Tow Boat Co., and the tug boat Robert S. Bradley of the Bradley Fertilizer Co., and both boats have gone back into the service. This repair work will now be carried to the steamship Herman Winter of the Metropolitan Steamship line of the New York and Boston service, which is due to arrive at the Fore River yard on Thursday, Sept. 19, for repairs due to the collision which this steamer had about three weeks ago.

While lying at the yard of the United Engineering Works, San Francisco, Cal., the steamer San Gabriel, owned by the Gardinier Milling Co., caught fire, supposedly from spontaneous combustion, and it was necessary to flood the vessel before the flames could be subdued. The vessel went on the rocks a short time ago and was to have been put on the ways the day following the fire for repairs.

The New England Navigation Co., of Portland Me., of which Mr. William H. Reed is president, has recently been organized with a capital of $500,000 for the purpose of building and operating vessels. The company has leased for a long term of years the property and water frontage of the old East End Yacht Club and will employ about 100 men, with a pay roll of $150,000. At the East End Ship Yard the keel was laid for a new schooner to be operated by this company, immediately after the recent launching of the four-master Victory, the latter of which is to form the nucleus of the fleet.

THE MARINE REVIEW

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WHERE HONOR IS DUE.

During the past summer season of trans-Atlantic travel unusual difficulties have been experienced in the engine departments of the various liners owing to labor troubles and the necessary shipping of unskilled hands to work the fires, pass coal, and oil the machinery. Occasional mention of the fact has been made in the columns of the press, but the matter is not of sufficient interest to the average landsman to warrant his giving it a second thought. In fact, he has a vague idea that the ship's fireman is a person of orbital morals carried to heave coal through the furnace doors, that the more he can heave the more useful he is, and likens him unto the knights of the shovel attached to a pipe-laying outfit. It is only marine engineers and those in actual contact with the engine department of a steamer who know the component parts of a first-class fireman.

The engineer of a tramp steamer, with a voyage of some ten thousand miles before him, can cheerfully accept the mixed crew furnished by the shipping master, confident that he will have his handful of men coaxed or cursed into shape early in the voyage, and, even if the gang are a worse crowd than usual, a few knots here or there are of little consequence, and fuel is economized. Different, however, is the lot of the engineer of the liner. With a half hundred men and four or more boiler rooms to attend to, steam to keep at its highest practicable point, and his abilities judged by a fraction of a revolution per minute, the strain of mail-ship driving is always with him. In the short trans-Atlantic passage little time can be given to straightening out the inefficient and refractory members of his watch, the vessel being expected to make time from the start to the finish of the trip, and little consideration being taken of the fact that the ship's fireman has a strong tendency to accumulate a farewell jag on sailing day. From sailing hour to the dropping of the pilot the engineer is trying to place the men at the fires according to his best judgment, being, of course, little helped in this task by the men, who are more pleased than otherwise to see trouble.

Though the quality of coal supplied to the large liners is usually of the best, or, at least, the best is contracted for, it often happens that a ship steams out to sea with several thousand tons of slate and other matter in her bunkers. The result would be depressing to any but the marine engineer, who immediately begins to contrive ways and means of persuading this matter to burn. With skilled firemen the experimenting is no difficult task, but if the crew are inefficient, sullen and lazy, the engineer's patience is indeed tried to the utmost.

According to the *Daily Mail*, of London, the stokers aboard the Lusitania on her maiden voyage proved to be a most refractory and malcontented lot. They made continual complaints and did their work throughout badly, with the result that it was impossible to get more than 150 or 160 revolutions.

When the Lusitania arrived at New York after averaging 23.01 knots across the Atlantic, it was pointed out that the fact of her machinery being new alone could account for her not breaking the Atlantic record on her maiden voyage, and that her engineers were nursing the great mass of machinery in their charge. It was not generally known then that the engineers on the big liner were "up against it" with a balky crew of three hundred men in the fire rooms. Now that the fact has been made public, the work done by the engineers under such circumstances is highly creditable to them.

This is the end of it that the outside world knows very little about, and, when commentators criticise the initial efforts of the 32,500-ton greyhound, great credit is due to the men who can keep the lid hard down on their troubles and blandly assure the inquisitive public that they have "nothing to say."

THE SHIPPING BILL.

It is promised that one of the first, if not the very first, measures to be introduced at the next session of congress will be one for the rehabilitation of the American Merchant Marine. The country is generally aware that this question has not received from congress the consideration which it deserves and that its defeat at the last session by filibustering was a direct affront to a considerable element of the nation. The bill had passed the house by a safe majority. Hitherto the stumbling point has always been the house. It has been known for years that its passage through the senate was assured whenever the senate had opportunity to vote upon it. Senator Carmack,

therefore, assumed an unwarranted liberty when he took advantage of the rules of debate in the closing hours of the session to talk this bill to death. It was not fair play. In the language of President Roosevelt it was not a square deal.

It was gratifying indeed that filibustering tactics can not be resorted to in the next congress. The session which opens next December is a long one and the bill will be placed upon the calendar at the opening. It will be presented with the endorsement of the administration and with the knowledge that the leading members of President Roosevelt's cabinet are in favor of it. It is unfortunate that such a measure as this should ever be treated as a party question. It is in no sense a party matter but it is one that vitally concerns the commerce of the nation. It should not be treated as a political issue at all. It is no more a political matter than the maintenance of the establishment of the army and navy. It is an integral part of our national equipment and should be maintained as such. The state into which it has been forced by the apathy of the government is shocking. It is a national disgrace, none the less so because only a few are apparently able to see it. Under normal conditions it is distressing that 93 per cent of our commerce should be carried abroad in foreign bottoms; under abnormal conditions, such as war between European countries, to say nothing of war between this country and any other nation, it would not only be distressing but dangerous. The country is entirely dependent upon foreign ships in times of peace to carry abroad the products of its fields and factories. It would be entirely dependent upon foreign ships to move its troops abroad in the event of war. It is perfectly plain that it might be impossible to get these ships and that the country would suffer a handicap from which it could not possibly recover for many years. There is constant necessity for the disposal of surplus products abroad in order to keep the mines and mills at their full output. In the event of war this foreign commerce would be the first to suffer with the inevitable result that domestic commerce would become entirely congested, entailing the closing of factories and the throwing of thousands of workmen out of employment and all this for the lack of a suitable number of American ships. Any measure that can serve to relieve this condition, even in part, deserves to be passed.

INFORMATION WANTED.

Editor REVIEW:—In common with the rest of the general public I have been impressed with the amount of space devoted by the press, both technical and lay, to the steam turbine, and have read more or less (mostly more) of it with close attention and considerable interest, and, also like the general public, absorbed the idea that the turbine had the ordinary type of engine, if not actually down and out, at least groggy. Recently myself and associates have been considering building a ship into which we contemplated putting about 3,000 H. P. We were so full, of the turbine idea that we gave the machinery hardly a second thought—it would be turbine of course. The firm with whom we consulted on our plans suggested that we look into the subject a little before spending our money, which we decided to do, though fully persuaded that it was a waste of time.

We found first of all the turbine installation would cost us about $60,000 more than the reciprocating engines complete in both cases. Though still satisfied that we would get the worth of our money in some way, we began to seek the compensating advantages. We talked with turbine manufacturers (when they gave us a chance to get in a word) and found that for driving electrical apparatus we were probably not misinformed, except in a few particulars which they assured us were quite unimportant. However, we found the problem of marine service very different. Naturally, we expected to save coal in quantities, but we found that the record is still with the reciprocating engine, much to our astonishment, and by a safe margin. We found several builders who offered to build and install the latter on a guarantee of not to exceed 1.4 pounds coal per horsepower per hour. The turbine men assured us that we were being misled, and that the engine men were unprincipled rascals, and that their recorded tests were not to be believed. We asked them to produce their own figures but for some reason they couldn't just get at them at the time, but they still solemnly assure us that they can do fully as well, if not better, than the reciprocating, though they decline to bind themselves by any guarantee. We thought we would look up the subject ourselves a little, but we were astonished to find that there seems to be no available information. We consulted several prominent engineers and while we found some who could tell us what the turbine was doing per kilowatt hour ashore, we also found that in each case this information came from the turbine manufacturer, who, singularly enough, also happened to be the builder of the electrical apparatus in each case. The steamship people we approached seemed to be rather uncommunicative, and the best we could get as to any ship was that her performance was "regarded as satisfactory." Somewhat mystified, and wondering how all the newspaper writers got such complete data where we couldn't find out anything, we passed over this point temporarily and inquired as to the weights of the rival types. We learned that the naked marine turbine weighed somewhat less than the engine, but that the greatly increased condenser capacity and auxiliaries required, together with the fact that the turbine could not be reversed and an entirely separate turbine must be fitted for the purpose, made the weights about equal.

Not yet discouraged, we compared the space required, and found that the floor space for the turbine was even greater, including auxiliaries, than for the engine. There was however a substantial saving in the headroom required. Feeling that we were at last "getting warmer," we looked further into this matter of headroom, and found that we would need it for skylight trunk, handling machinery, etc., so that we were no better off after all.

Reluctantly giving up hope of finding something which would help bring us a return on our $60,000, we turned to the statement that with the turbine there would be absolutely no vibration, with the feeling that here at least the turbine would be on its own ground and stood secure. Merely as a matter of form we made some inquiries along this line. We certainly had no fault to find with the extent and variety of the information we received; it reminded us of Mark Twain's description of the cigars he smoked in Europe. The silence of those who

have rushed forward to assure us that the turbine ship is free from vibration is almost deafening. We found that the turbine, while it may run absolutely still on the testing floor, when coupled up to a propeller is a very different thing; that the disturbance probably originates at or near the propeller and is not necessarily dependent on the type of motor employed; that the question of vibration is a complex one, made up of position of observer, speed of rotation, type and immersion of propeller, trim of ship and cargo, etc., and that, further, there are well authenticated instances of vibration having been observed and recorded in tow-barges without machinery of any kind. We personally observed a most annoying and uncomfortable instance of vibration in a passenger ship lying at her dock with nothing but the electric lighting apparatus running. We learned of at least one instance of a turbine having been removed, and replaced by a reciprocating engine, said to be on account of vibration, but did not hear of any instances of the reverse.

We found that there was no saving to be expected in attendance, the crew being the same in both cases. We concluded that maintenance and repairs would be somewhat less with the turbine but were unable to find any figures for it. There are at least two aspects to the subject of repairs; one the cost of the repairs themselves, the other that of delay. In the course of our investigations we found turbines totally disabled through one or two of the blades coming adrift and stripping several thousand others, and the possibilities of trouble with these little mischief makers seemed to us almost infinite, when it is considered that in a turbine of very moderate power, as marine units go, there are many thousands of them. We could not help remembering that there are innumerable instances of ships coming home with disabled, or at least crippled, engines, and wondering at the chances of a ship with a turbine.

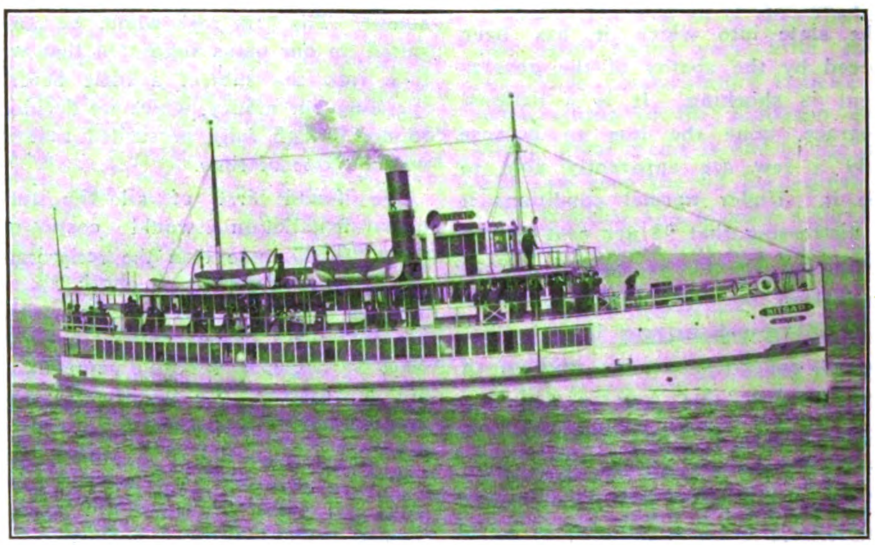
We did find, however, that the turbine probably made the Lusitania a possibility. In a naval ship, or in a vessel intended as an auxiliary cruiser, as she is, and for which reasons the British government advanced money to build her and her sister ship, low head room is valuable for the protection of the machinery. In her case besides, it would probably have been impossible to get the required 70,000 H. P. with reciprocating engines on account of the great size and weight of the shaft forgings, due to the relatively slow speed of revolution. The same reason made it possible to bring the smaller screws of the turbine in closer to the hull and to submerge them so that there is practically no liability of racing in a seaway. This last is really the most important of all in a merchant ship, because it tends to increased comfort and makes far better speed in bad weather.

But we don't want a Lusitania, even in miniature, and Mr. Editor, since you have given the turbine a good deal of notice at different times, we beg to ask if you canont help us to find an excuse for spending that additional $60,000. Somewhere there must be somebody who knows about the turbine who isn't trying to sell them, or find a satisfactory explanation for having bought one. We note that the London *Engineer,* in a recent issue remarked that the popularity of the turbine is largely due to optimism. Can this be true?

A PUZZLED OWNER.

A NOTABLE PACIFIC COAST STEAMER.

Among the many small passenger steamers comprising the Puget Sound mosquito fleet, the Kitsap, owned by the Kitsap County Transportation Co., of Seattle, Washington, is undoubtedly the most notable. This craft has a record speed of 18⅛ miles per hour sustained for over three hours, which makes it the fastest commercial passenger steamer of its size on the Pacific coast, if not in the country. The boat is used on a regular run between Seattle and Paulsbo on Puget Sound, a distance of thirty miles, and is notable in many ways aside from its unusual speed.



STEAMER KITSAP.

Built in the summer of 1906 at Portland, Ore., by Joseph Supple, the little steamer made the 170 miles sea voyage from the Columbia river bar to Puget Sound unaided and entirely with its own power. The hull is 137 ft. long on the water line with a 22-ft. molded beam. The frame contains five 10 by 10-in. keelsons, one 14 by 16-in. boiler keelson and one 10 by 14 in. engine keelson, all of fir; the ribs, stem and stern posts are of oak. The hull is double sheathed; the inner planking is 2-in. cedar and fir laid diagonally; the outer planking is 2½-in. dressed fir. The cabins and superstructure are of fir throughout with hardwood trimmings.

A triple expansion condensing engine, 12, 19½ and 32-in. in diameter by 18-in. stroke drives a single bronze screw 6½ ft. in diameter with a 9-ft. pitch. The indicated horsepower at 300 r. p. m. (normal speed) and 275 lbs. boiler pressure is 750. The steam is generated in a double ended Seabury water-tube boiler rated at 800 H. P. The boiler carries 275 lbs. per square inch pressure which is the highest boiler pressure allowed any steamer on Puget Sound. The engine, boiler and auxiliary machinery were built by the Chas. L. Seabury and Gas Engine & Power Co. Consolidated.

Crude oil, sprayed into the furnaces by steam blown atomizers, is used for fuel. When running normally the Kitsap burns a barrel of oil in 19 minutes or at the rate of nearly 100 gallons per hour. With oil at $1.00 per barrel, Seattle price, the fuel cost is practically $3.00 per hour. One barrel of oil is equivalent to 0.4 of a ton of Puget sound coal which is now costing $4.50 per ton. On this basis

one barrel of oil costing $1.00 does the work of 0.4 tons of coal costing $1.80. Aside from this the deliveries of coal are very irregular and the oil is much cleaner, easier and more economical to handle. These are the reasons that the Kitsap and 75 per cent of the other steamers on Puget Sound burn oil.

One hundred electric lights, the current for which is furnished by a 7-kilowatt DeLaval turbo-generator, are used to illuminate the cabins. The turbine runs at 30,000 r. p. m. driving the generator, through reducing gears, at 3,000 r. p. m. This set has the special advantage of exceptional compactness and has proven itself to be economical and reliable in operation.

The entire mechanical equipment is decidedly superior to the average small passenger steamer and compares favorably with that found in the finest private yachts. The wisdom of incurring the extra expense which this equipment involved has been thoroughly demonstrated by the speed, minimum repair bills, economy and reliability of service that has been obtained from the Kitsap.

As was stated in the beginning the Kitsap is capable of a sustained speed of 18⅛ miles per hour; the speed on the every day run is 17 miles per hour. The boat is licensed to carry 300 passengers.

The officers of the Kitsap County Transportation Co. are: W. L. Gazzam, president and B. F. Morgan, general manager.

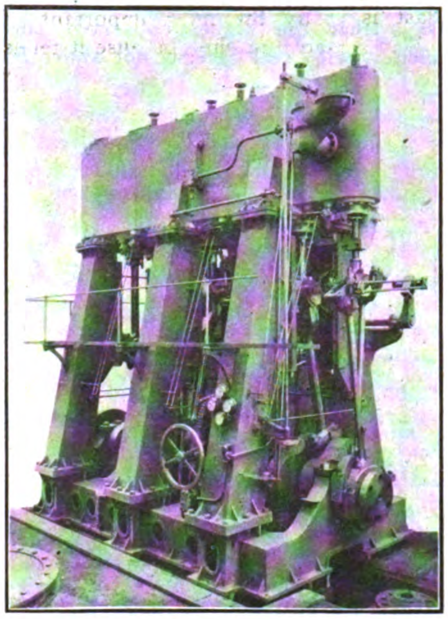
ELECTRIC BOAT CO. TO BUILD SUBMARINES.

Contract was awarded by Secretary of the Navy Metcalf on Sept. 29 to the Electric Boat Co. of New York, for the construction of seven submarine torpedo boats out of the appropriation of $3,000,000 made for this purpose by congress at its last session. Four of the boats will be of the same size as the Octopus, the successful competitor in the contest conducted by the naval board appointed for that purpose. Three others will be of the same type but of greater displacement and higher speed both as regards surface and submerged conditions.

The barge Santiago of the Gilchrist fleet, which sank at the dock at Escanaba while loading on August 20, and which has just completed repairs at Milwaukee, will be towed to Toledo to unload. The vessel is in charge of the underwriters, having been abandoned to them after sinking at the dock at Escanaba.

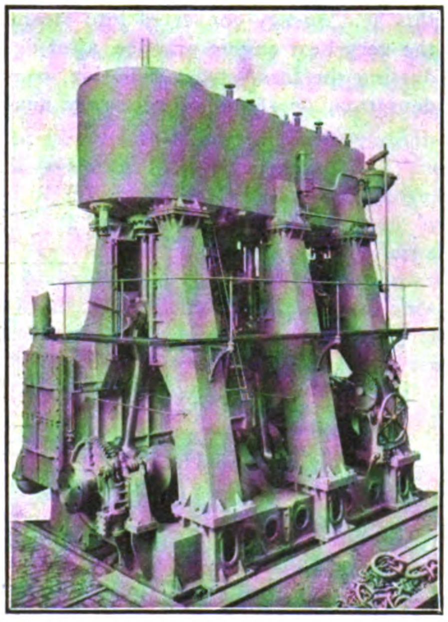
3,000 H. P. MARINE ENGINES.

We have been favored by Messrs. Richardson Westgarth & Co., Ltd., engineers of Sunderland, England,



3,000 H. P. MARINE ENGINE.

with the accompanying illustrations of the 3,000 H. P. marine engines which they have fitted into the steel screw steamer Rotterdam, built by the Northumberland Ship Building Co.,



3,000 H. P. MARINE ENGINE.

Howden-on-Tyne, to the order of Messrs. Furness Withy & Co., for their Rotterdam-Baltimore line. The Rotterdam is a vessel of 9,000 tons cargo carrying capacity, and her length is 425 ft. The loading and discharging facilities are in excess of what is usual. She has 12 derricks and ten powerful steam winches. The machinery has been specially designed and constructed from entirely new patterns by Messrs. Richardson, Westgarth & Co., Ltd. The cylinders are 28 in., 46 in. and 77 in. diameter by 54 stroke. The go-ahead and go-astern guides are carried on independent front and back columns. The crank shaft is in three interchangeable parts, and is made of ingot steel throughout, whilst the bed plate is sufficiently deep to bolt direct on to the top of the tank without intermediate seating. Every bearing throughout the engine is adjustable and easily manipulated while the engine is working. Steam from the low-pressure cylinder is conveyed to the condenser by a separate exhaust pipe, and space is allowed on top of the tubes for steam to spread the full length of the condenser, the condenser tubes being packed with close-ended screwed brass ferrules and cotton cord packing. Steam is supplied by three boilers which work at 180 lbs. pressure. During the trial runs of the steamer, the machinery worked with smoothness and efficiency, over 3,000 I. H. P. being obtained with 69 revolutions, with less than two in. of draught at the fan, while a mean speed of 12¾ knots was obtained.

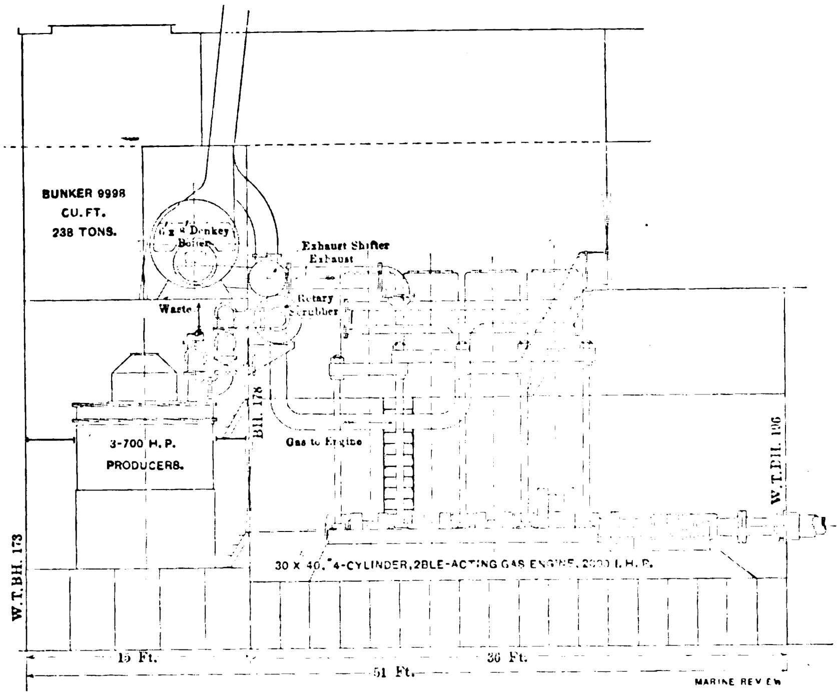
TORPEDO BOAT GOYAZ.

The first-class torpedo boat Goyaz, just completed by Messrs. Yarrow & Co., of Poplar and Glasgow, for the Brazilian government, left Gravesend on Wednesday, Sept. 4, for Brazil. The vessel is 152 ft. 6 in. long, by 15 ft. 3 in. beam, and has a speed of 26½ knots. Instead of the usual reciprocating machinery, it is propelled by turbines combined with a small triple-expansion reciprocating engine, the latter being used for cruising on account of its superior economy at slow speeds. The Goyaz is designed to carry two 47 mm. quick firing guns, and two 18-in. torpedo tubes. The hull is of the Yarrow standard type for first-class torpedo boats, being in all respects similar to 26 others that have been built for the Chilian, Austro-Hungarian, Japanese and Dutch governments. Those built for the Japanese government did excellent service in the Russo-Japanese war, and the Austro-Hungarian government are themselves building twenty vessels exactly to this design.

Capt. Wm. S. Carloss has been appointed master of the steamer Caledonia to succeed Capt. J. W. Nicholson, deceased.

MARINE MOTIVE POWER OF THE FUTURE

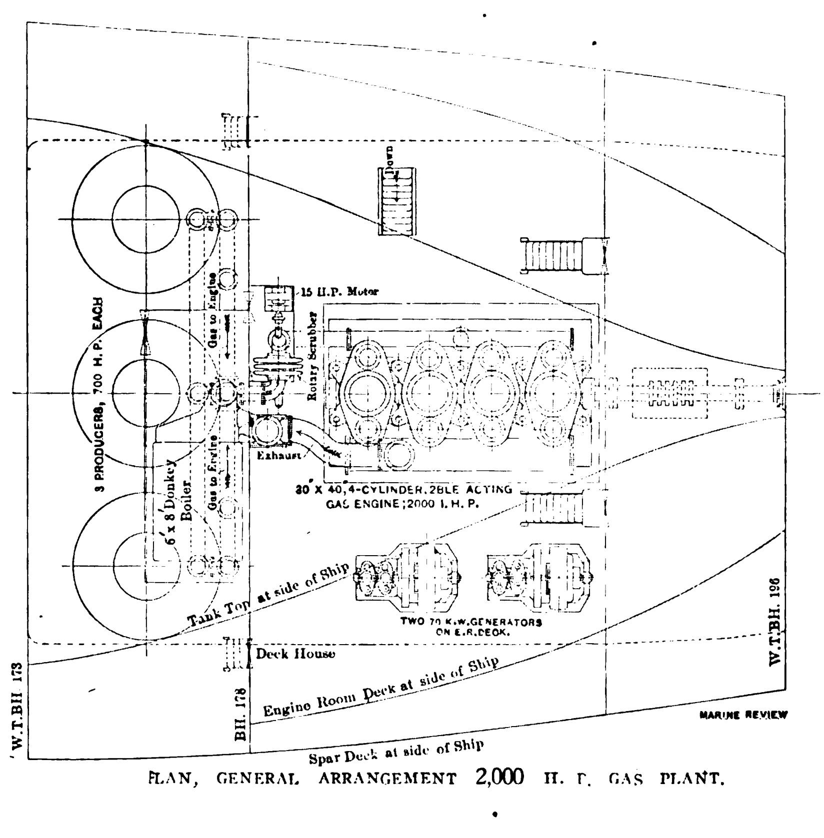
That the steam engine, even in its most refined and highly developed form, is a crude and extravagant means to the transforming of the energy of heat into work, has long been known and conceded by engineers the world over, and in the term steam engine is necessarily included the boiler and the various appurtenances necessary to the formation and use of steam as an agency for the conveyance and application of the heat used and absorbed in its production. Even with all the contributing advantages of superheat, reheaters, mechanical heated draft, mechanical stoking, feedwater heaters and economizers, careful insulation, etc., the steam engine of whatever type, reciprocating or turbine, is yet a wasteful and imperfect device. To classify them "from the worst downward," would not be far wrong. The causes of this waste are various; imperfect combustion, faulty stoking, waste of coal through grates, lack of proper control of air supply, imperfect transfer of heat in boiler, losses in chimney gases, radiation, etc., are important, but by far the greatest loss is that due to the heat rejected with the exhaust steam.



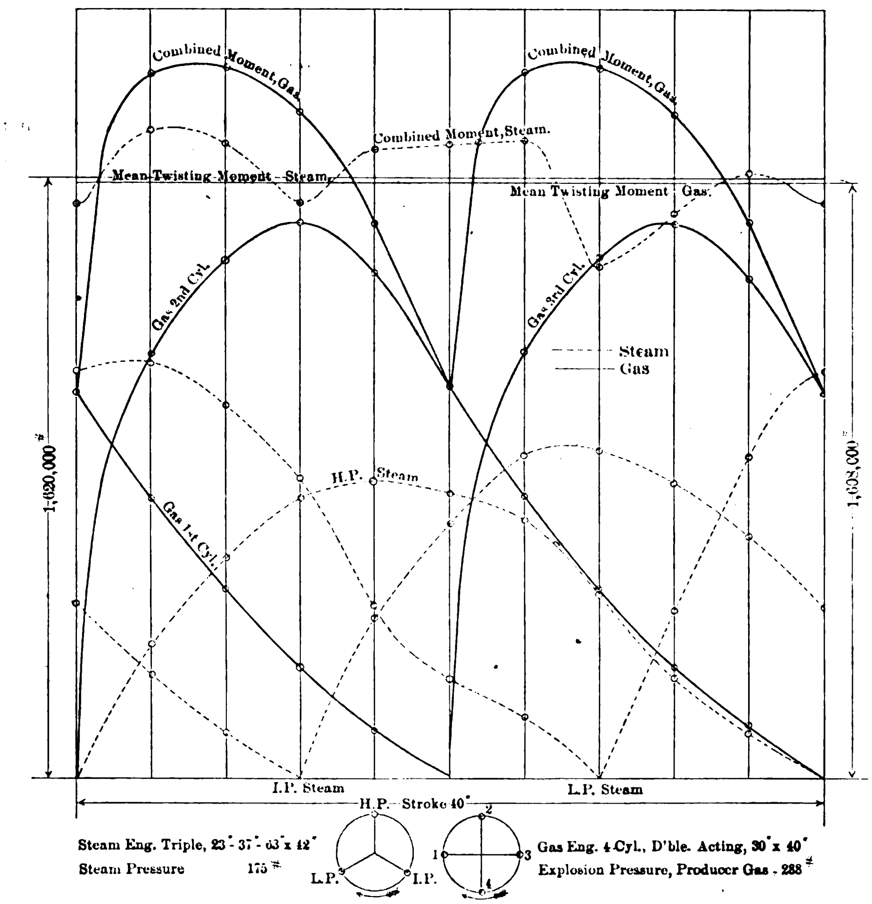
GENERAL ARRANGEMENT OF 2,000 H. P. GAS PLANT.

The boiler losses amount to upward of 20 per cent, indeed Donkin's exhaustive tests show that of over 300 tests of various types of steam boliers, including water-tube, Scotch marine, locomotive and portable, the average efficiency was 66.8 per cent, the best noted was 72.4 per cent. (Donkin, Heat Efficiency of Steam Boilers). Prof. Alexander Kennedy says that the highest observed efficiency, with real care, is not above 80 per cent, (Lecture, Royal Inst.). Of this heat energy converted into steam, the very best engine practice, after deducting the losses from radiation, condensation, operation of necessary auxiliaries, heat rejected with the exhaust, etc., does not utilize over 20 per cent; the average, even in ordinarily good practice in marine work, does not exceed 15 per cent, the difference being due largely to the fact that conditions of space and weight prevent the marine engineer taking advantage of refinements of practice which are available on land. Neither does the type of engine have much bearing on the subject, for although the reciprocating has been and is in almost universal use for marine work, and although the turbine has made rapid headway in some special services, it has yet failed to show any better economy than its older rival, and so far as the general service, which is of course the cargo ship, is concerned, it is merely an interesting engineering development. In respect of economy however, the turbine of course works under the same disadvantages as to waste of heat as the reciprocating, and the trouble is due to fixed natural laws and may not be avoided by a variation in type.

For many years it has been known that the heat value of coal in a gaseous form is higher than in the form of a solid, that is to say its realizable or commercial heat value, and that by converting its fixed and volatile carbons into fixed gases as in a producer, so called, and afterwards burning these gases in an internal combus-



PLAN, GENERAL ARRANGEMENT 2,000 H. P. GAS PLANT.



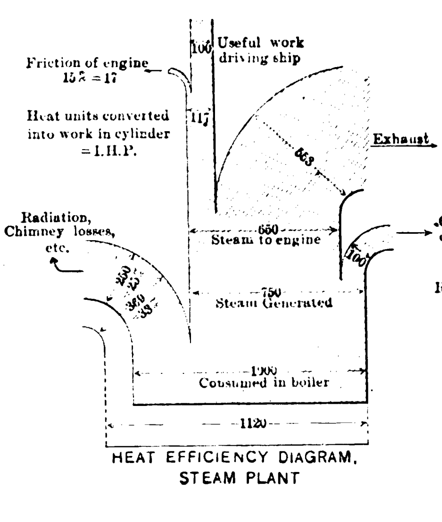
COMPARATIVE TWISTING MOMENTS, STEAM & GAS ENGINES, 2000 I.H.P.

MARINE REVIEW

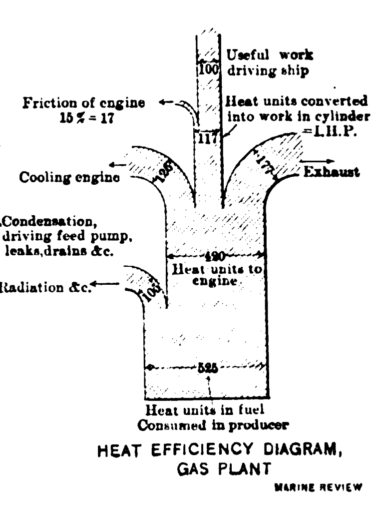
tion engine, vastly better economies were possible, but the practical working out of a successful engine did not come until the invention of the "Otto cycle," in 1876, and then for several years its use was restricted to illuminating, or city, gas. The first gas engine was tested on producer gas in 1879, by Dowson, who had been a pioneer in the development of the producer, which was then chiefly employed for making cheap, low-grade gases for heating. The results of those early tests are given in the reports of the British Association, 1881, and by D. K. Clark, 1882, and showed conclusively that even then, so far as economy was concerned, the combustion motor was far in advance of the steam engine, but other difficulties retarded its adoption for some time. But the advances made since that time have been nothing short of incredible. Where the steam engine was generations in improving its efficiency even 25 per cent, the gas engine, starting in where the steam engine in its best form stands today, has, in 18 years been improved to a point where its efficiency has nearly doubled, (Clark, Lecture Inst. C. E., 1904). Those who have followed the subject must have noted the strides made in the building and adoption of gas engines in sizes running into the thousands of horsepower, by the big steel companies. Of course these are for the most part operated on blast-furnace gas, which is really a producer gas of an inferior quality but the status of the gas engine as a prime mover in large sizes has been securely established. In Europe, especially on the Continent, the gas engine is employed to an extent as yet undreamed of here, in fact progress with internal combustion engines has been almost wholly European, where the fuel question is of much more importance than with us. Much attention has been given there to the liquid fuel, either in the form of the heavier oils and petroleum residium for power purposes, or the lighter distillates for motor vehicles and launch work, but the greater economy and safety of the producer has practically crowded the other fuels to one side, except in cases where the relative first cost due to transportation, overbalances the thermal efficiency.

In November, 1906, in Germany alone, a country not so large as Texas, there were in use 161,000 H. P. of gas driven blowing engines of an average of 1,200 H. P. each; 206,300 H. P. of gas driven dynamos of an average of over 1,000 H. P.; 17,000 H. P. of rolling mill engines averaging over 1,500 H. P. each; together with many other applications bringing the total of large sizes up to about 400 engines of about 420,000 H. P., without taking any account of the thousands of applications of small and medium sizes, all working on producer gas. The very troubles encountered at the outset brought so many workers of ability into the field that the result has been an accession of strength seldom found, and some of the recent examples of well designed engines have shown an efficiency with oil fuel of 41.7 per cent on city gas of 42.7 per cent, and on coke oven gas of 38.6 per cent (Junge, Evolution of Gas Power, 1906), compared with the steam engine efficiency of 15 per cent to 20 per cent.

The gas producer in its earlier forms was exclusively of the pressure type. It is not necessary to go here into a description of the method of operation of this type since it has been largely superseded by the "suction," type, and for marine work the latter is the only type available from considerations of space and weight. The suction type was long confined to anthracite and coke for engine work,



HEAT EFFICIENCY DIAGRAM, STEAM PLANT



HEAT EFFICIENCY DIAGRAM, GAS PLANT

MARINE REVIEW

on account of the difficulty of eliminating the tarry particles carried over with the gas. The exhaustive and costly researches and experiments conducted by the U. S. Geological Survey at the fuel testing plant at St. Louis, in 1903, with every grade of bituminous coal, both as fuel for steam boilers and in gas producers demonstrated so thoroughly the advantages of gaseous fuel, and the enormous saving by the use of combustion engines (Report on Fuel Test, U. S. Geological Survey) as to stimulate American engineers to renewed application and activity, with the result that the suction gas producer can now be worked successfully with bituminous coal on engine work and deliver a practically clean gas fit for continuous operation of gas engines.

In England and Germany much more attention has been paid to adapting the producer to marine work than here, and some installations of units up to 1,000 H. P. have been made with such gratifying results that ships of 7,000 tons are now being constructed and fitted with producers and gas engines. The saving in cubic space alone in a 7,000 ton ship is placed by one of the largest ship building firms in Great Britain at 13,000 cu. ft. as compared with steam. This saving results not only from the reduced space required for the apparatus itself, but from the reduced bunker capacity required. In the United States, while not much attention has been paid to the producer for marine work, considerable thought has been given to the combustion motor using liquid fuel, and units have been constructed and are in operation in regular service up to 500 H. P. The conditions of every day service have been satisfactorily met and the motor may be said to be thoroughly worked out. The absolute reliability of the combustion motor using a fixed gas and running at ordinary speeds as compared with engines using a liquid fuel and generally operating at high rotative speeds has not now to be demonstrated. The latter conditions are those with which all are more or less familiar in automobile and launch work, and have brought about a feeling that the whole race of combustion engines are unreliable, than which nothing could be further from fact. In discussing the use of combustion engines in the merchant marine we will consider their application to a modern lake cargo steamer, since, as has been recently noted, about 75 per cent of the merchant steam tonnage of the United States is built on the great lakes, and we will endeavor to draw a comparison between the steam and the gas plant in a ship of say about 10,000 tons cargo capacity. The power to be provided will be about 2,000 indicated. The first features to be compared are of course structural as regards space and weight in the ship, and the figures for the steam plant are from a well known ship of the latest type, and those for the gas plant are from a design worked out for the same ship, the gas engines designed for 90 revolutions per minute:—

	Steam.	Gas.
Weight of plant complete (including water in boilers), no fuel	625,600 lb.	300,000 lb.
Fore and aft space, exclusive of usual athwartship bunker	60 ft.	50 ft.
Additional for bunker...	12 ft.	None
Total fore and aft space.	72 ft.	50 ft.
Height of shaft center above base line	8 ft. 2 in.	8 ft.
Diameter of propeller....	14 ft. 6 in.	14 ft. 3 in.

Here we have a saving in weight of over 160 tons, and a saving in length of hold of 22 ft. The increased length of hold is brought about partly by the fact that the necessary fuel can be carried entirely over the producers in the space now given over to smoke stacks, fan, uptake, air heaters, feed heaters, purifiers, steam pipes, etc., and the ship be fueled with exactly the same facility as now, and whether the under-feed or the hopper-feed type of producer be adopted, the fuel will be in the right place and require little passing or trimming. Coming to the question of fuel capacity and changeable load we are at once brought face to face with the question of economy. Accordingly we have compiled a table of the coal consumption of a representative list of modern lake steamers as taken from their steam trials, and which have been selected from a large number so as to include about every type and combination of equipment in use. The names of the steamers and the parties making the tests are withheld for obvious reasons.

As will be seen the average of the entire lot is 1.8 pounds per I. H. P. per hour, and it is to be noted that as usual in making such tests, all auxiliaries that can possibly be dispensed with are cut out, which is all right for the purpose of getting at the fuel economy of the main engines and boilers, but does not necessarily represent the fuel cost of actual operation. However there is no difficulty, even on the basis shown, in cutting the fuel cost in half by the use of producers and combustion engines. No less an authority than Sir John Thornycroft puts the average results in operation at 0.8 pounds per I. H. P. per hour (See Proceedings Institute of Naval Architects, 1906). The writer has seen producer plants tested out at a lower figure with slack coal. It is (considering the relative stad-by losses in port, etc.) absolutely safe to consider the relative fuel operating cost as at most 0.45 to 1.0. A steamer of the size under consideration consumes on a round trip between Lake Erie and the head of the lakes about 300 tons, going light one way in good weather and with fair despatch. Quite a large percentage of this is used by auxiliaries of a very wasteful type, such as the lighting plant, ballast pumps, feed pump, fan engine, ash hoist engines, deck winches, steering gear, capstans, etc., and a further percentage is due to radiation, condensation, etc., the amount of which can be estimated from the amount of coal actually consumed at dock with nothing moving. Of course there is a certain amount used also for heating purposes, and in spring and fall and early in winter this reaches a considerable figure, but so do the radiation and condensation losses increase for the same reasons. We may therefore, without hesitation, expect a saving of at least 150 tons per trip, and not by any means an insignificant proportion of this will be due to the saving at auxiliaries and reduced

COAL CONSUMPTION OF VARIOUS LAKE STEAMERS.

FROM OFFICIAL TRIALS.

Ship.	Type of Boiler.	Firing.	Draft.	Type of engine.	Tests.	Coal lbs. per IHP per hr.	Tested by
1	Scotch	Hand	Howden	Triple	1	1.69	A
2	"	"	Nat.	"	1	1.79	B
3	W. T.	Stoker	Forced	Quad.	5	1.99	C
4	Scotch	Hand	Nat.	Triple	5	2.71	D
5	W. T.	"	"	Quad.	4	2.33	E
6	Scotch	"	"	Triple	1	1.62	F
7	"	"	E. & C.	Triple	3	1.89	G
8	"	"	Howden	Quad.	1	1.62	H
9	W. T.	Stoker	Induced	"	2	2.08	J
10	Scotch	Hand	E. & C.	Triple	1	1.45	K
11	"	"	"	"	3	1.70	L
12	"	"	"	"	2	1.77	M
13	"	"	Howden	"	1	1.68	N
14	"	"	"	"	1	1.65	O
15	"	"	"	"	1	1.54	P
16	"	"	"	"	1	1.40	R
17	W. T.	Stoker	Induced	Quad.	4	1.68	S
18	"	"	"	"	4	1.77	T
					42	av. 1.80	

radiation and condensation and stand-by losses. We have therefore a saving in total weights, fixed and changeable, of considerably over 300 tons, and a saving in fuel cost alone per trip of about $450.00, in average good weather. There is also a further saving in the help required, because, with ordinarily simple conveying and feeding arrangements, one man on watch would be ample to care for the producers, the only operations to be performed consisting of looking after the feeding apparatus, and about once in 12 hours to remove the accumulated ash. Cleaning fires, as with the boiler plant, is done away with, together with the heat, dust and poisonous gases attendant upon it. The saving in fuel is not alone represented by the above figures, because with the producer it is possible to use satisfactorily grades of fuel which can not be used in the boiler furnace, as some of the poorest grades of bituminous coal have shown remarkably high efficiency when gasified in the producer. Anthracite or coke can be used with even better economic results than bituminous coal, though for lake ships they are probably out of the question. The stand-by losses of a steam plant are quite serious even when no steam is being used for moving ship or for other purposes. Tests of a number of installations showed an average coal consumption of 0.21 pounds per hour per horsepower of plant, merely to keep up steam. Tests of an equal number of producer plants, where the consumption is merely that of a dead or dormant fire, showed 0.016 pounds per horsepower, or less than 1/10 that of the steam plant. Of course the reason is that in the gas plant, unless gas is being drawn off there is no combustion taking place. There are several thousand feet of steam pipes and hot water pipes aboard the modern steamer, and even though carefully covered and protected, the loss of heat goes on without interruption and more or less rapidly. They can not be shut off because from almost any one of them steam is likely to be demanded at any moment and must be provided.

It will probably be well at this point to give some description of the proposed gas plant. There would be three producers of about 700 H. P. each, normal capacity; in the event of complete failure of one from any possible cause the remaining two can easily take up and carry the load because the overload capacity of a producer is much greater than of a steam boiler.

They would be of the suction type, that is to say, the type in which the air and vapor are drawn into and through the fuel supply by the action of the engine drawing gas out, and so in respect of all ordinary variations of load are automatic. The question of maintaining a supply of gas during manoeuvering, stoppage, etc., will be dealt with later. Of these producers there are a number of designs, but in this, as in other lines, each has its contending claims, and we will not discuss that feature; the main point is that there are a number of suction producers which are working satisfactorily and the features peculiar to marine work can be described later at the proper point. The engine would be of the four-cylinder, double-action type, the latter feature being common to all the larger sizes for marine work, the problem of cooling the piston and rod having been satisfactorily solved. The cylinders would be approximately 30 in. x 40 in. The engine would draw its supply of gas direct from the producer and exhaust directly into the atmosphere. It would be manoeuvered and handled with a direct reversing gear of the same type now employed with steam, and operated by compressed air. An air-pump driven off the main engine, maintains an air pressure of 150 to 200 pounds in a large air receiver which can be located anywhere most convenient. Neither reversing propellers or clutches of any sort will be employed. There will be two auxiliary gas engines driving direct-connected generators of about 70 KW. capacity, and furnishing current for lighting and for all auxiliaries, one set being always in reserve. A small air-pump is also driven off each of these auxiliary engines and all the air-pumps will be automatic as in the familiar air-brake system, the idea being to insure a constant supply of air under pressure, whether the main engines are working or not. In handling, starting, reversing, etc, of the main engines, all the functions are performed by the air. Thus, assuming the engine to be at rest and it is desired to start; air is admitted to one or more cylinders and as soon as the engines have made one or two revolutions and gas drawn into the other cylinders, the air is cut off and all cylinders worked on gas if desired, or as many as be needed may be worked on gas up to full power. Similarly, the engine may be slowed down by cutting out cylinders, either on one or both ends at a time, stopped, reversed, started by air and backed at full power, with all the facility of the steam engine. Indeed, in reversing at full speed the gas engine has a substantial advantage over the steam engine for the reason that it is well known that to reverse the ordinary triple or quadruple engine under such conditions is almost impossible, or at best extremely difficult, owing to the fact that the energy which is being imparted to the ship by the propeller is, at the instant of reversal, transferred to the propeller by the ship, and, in addition to overcoming this, a current of water must be set in motion in the opposite direction. The supply of air may be admitted to all cylinders at once, if necessary, providing power far in excess of even the momentary reversal requirements. As some way of heating the ship must be provided for, a small boiler to furnish steam at 10 pounds or 15 pounds pressure is installed and served by a portion of the exhaust gases from the main engines and which are exhausted at a temperature of 350° to 450°, amply high to generate steam of even much higher pressure, and thus the heating is done absolutely without cost. It has also been proposed to arrange this boiler to be fired with coal in case exhaust gases from the main or auxiliary engines are not available. An ample supply of hot water for all possible purposes is available from the water-jackets of the cylinders at a temperature of about 140°, also without cost, a point that will be appreciated when decks are to be cleared of snow and ice and for scrubbing down in cold weather.

To insure that the engines may be instantly available when manoeuvering ship there would be fitted a small exhauster, motor driven, which can be started at will by a switch at the handling platform, and which will maintain a flow of air and vapor through the producers with the engines stopped and thus insure a full supply of gas when wanted. This exhauster can be allowed to run as long as the engines are being handled and shut off when convenient.

The elimination of the tarry vapors before referred to, is accomplished partly by causing the tar-bearing gases, which are the first distilled, to pass though the hottest part of the fire, whereby they are either consumed or converted into a fixed gas, and partly by the use of a centrifugal scrubber in place of the ordinary coke and excelsior scrubbers, and in which, after the gas has been intimately mixed with water in a fine spray, it is separated by centrifugal action, which

carries off, not only all the moisture, but also the dust and the tarry particles which have been condensed in the passage through the spray. Engines are now in successful use ashore with bituminous suction producers up to very large sizes, with the engines running continuously from week end to week end without stop, and a record of 100 days, with only one stop, has been made.

The matter of auxiliaries is nearly as important aboard ship as the main engines, and we have given much thought and investigation to the subject. The operation of such auxiliaries as the steering gear, pumps, deck winches, capstans, etc., by electricity is no novelty; they have been so operated for many years and are regularly made and sold as standard apparatus by several reputable and well known concerns. The windlass, however, presents somewhat different and more complex problems than any of the other auxiliaries but a solution has been found for this also. By separating the windlass and forward capstan and making both forward and after capstans alike, motor-driven, thus practically restricting the windlass to the business of handling the anchors, it is possible to use the same drive as now employed and use compressed air as the agent, and as at such times the demand for air for other purposes is practically nil, it works out just right. Of course the objections to piping steam do not apply to air, as there is no condensation and no loss (other than that of line friction), and no danger from damage from leaking or bursting pipes.

The advantages of motor-driven auxiliaries are apparent, especially in lake service where they are in such frequent use. They get rid of all danger from freezing, there is no delay for warming up, no danger from water in pipes or cylinders, and their use cuts out numberless pipes, valves and fittings, with their continual leaks and troubles and cost of maintenance and of fitting out and laying up. Doubtless they would have been adopted long since as they have in other lines but for the existing steam plant. Of course the motors would have to be of the waterproof type but as they never run continuously, nor, as a matter of fact, for more than a minute or two at any one time under load, this would be no disadvantage.

The matter of maintenance is one that has also to be considered in any comparison of the two systems, and here the odds are all in favor of the gas plant. The elimination of the enormous boilers under high pressure are a feature of the bodern ship, and their constant care and repairs, together with the fact that the larger and heavier the boiler the shorter its average life, is an important consideration. The life of the Scotch boiler is variously estimated at from 10 to 15 years. Numbers of lake ships have been reboilered in less than 10 years. The cost of repairs at 10 years and upwards rapidly increases. With the despatch now given the cleaning of boilers becomes a matter of the utmost importance, and the large boilers now employed cannot be cooled down, cleaned properly, and got under steam again, in the available time, without serious injury. It is only fair to the boiler to say that probably nine tenths of its troubles are really traceable to the care, or lack of it, that it receives. An attempt has been made with more or less success, to mitigate these evils by the fitting of purifiers, but it is at least a debatable question whether the cure is not fully as bad as the disease, from the fact that their use entails still further complications to a plant that has been for some years growing more and more intricate in detail, and if the purifiers themselves are not carefully attended to they fail utterly in their purpose without avoiding any of the expense and risk involved in their operation and maintenance. The operation of boilers not kept properly cleaned entails a rapid falling off in efficiency, to say nothing of the risk involved. The greater part of the time and expense of laying up and fitting out is due to the boilers and their attendant piping and equipment, and it is most probable that an examination of the accounts would disclose that 80 per cent of the cost of steam plant maintenance is outside of the main engines. No small part of the ship's general expense in cleaning and painting is due to the smoke and cinders issuing from the stack or from the stacks of other ships. The rapid corrosion of tank tops and boiler decks due to the water continuously washing about and the difficulty of keeping them clean, is traceable to the washing out of boilers, and to leaks. The passing of the boiler would relieve the ship as a whole from the operation of a great part of steamboat inspection laws, which have, in respect of boilers and piping, become onerous.

The producer should last as long as the ship or practically indefinitely, as no part is subject to pressure or strain and only the fire brick lining to heat. To all intents and purposes the duty is no more severe than that of a common stove and to ordinary intelligence they are equally simple. Figures are available showing in one instance of a 4,000 H. P. plant total repairs of less than $150.00 per annum almost entirely fire brick and labor setting same. The plant referred to has been in operation since 1900. Another plant in operation two years (1,000 H. P.) supplies a statement that the entire repairs in that time consist of the services of a bricklayer for 24 hours. With respect to the maintenance account of the engines it may be taken as being about the same for both types; there is no reason why there should be any difference of note, both receiving equal care.

With respect to care, the gas plant requires nothing more in the way of skilled attendance than the other. With respect to availability, however, there is no comparison. From the time of lighting a fire in a producer till clean rich gas is available, up to the capacity of the plant, need not take more than 30 minutes at any time, with little effort it may be done in half the time, and from a dormant fire in from three to five minutes. The supply of gas is almost perfectly automatic, the greater the demand for gas the more air and vapor are drawn through the fire and the greater the supply of gas, and, similarly, when the demand stops combustion ceases and fuel expense is at an end.

It may be added that, among other things that will readily suggest themselves upon slight consideration, the elimination of the fireman as a factor in the labor problem is not the least.

A diagram suggested by Dowson (Producer Gas, 1906), and exhibiting graphically the relative heat efficiencies of the two systems, may be interesting. In the steam plant diagram the boiler is given credit for an efficiency of 75 per cent, which, it will be noted, is materially better than that credited to any of those observed in Donkin's trials. The engine is credited with an efficiency of 18 per cent, considerably better than usually obtained even under favorable conditions in marine work; the friction losses (which includes the losses due to driving pumps as well as actual friction), are put at 15 per cent. While this may seem high it accords with careful observation; Seaton estimates these losses as lying between 12 per cent and 18 per cent, and in any event the same proportion of loss is charged against both the steam and the gas engine. For further comparison the steam diagram is extended, as per

dotted lines, to show the result with a boiler efficiency of the average as shown by Donk'n's trials (67 per cent).

In the gas diagram the producer efficiency is taken as 80 per cent (although 90 per cent has been reached with even small plants), the engine efficiency at 28 per cent (upwards of 30 per cent is common practice), the loss in jacket cooling 30 per cent. Therefore if any error exists in the comparison it is in favor of the steam plant and the figures actually correspond with better results than usually obtained with steam while not representing every day practice with producer gas plants. The data as to gas plant performance are from Dowson, Clerk, Crossley, Junge, Capitaine and others, as well as from the reports of the coal testing plant of the U. S. Geological Survey and from various reports of tests and trials of plants appearing in the proceedings of various engineering societies, and are believed to represent the best and most accurate information available.

It will be seen from the diagram that for every 100 units of heat usefully expended in driving the ship there is required an expenditure with the steam plant of 1,000 heat units, with a boiler efficiency of 75 per cent, and of 1,120 with a boiler efficiency of 67 per cent, while with the gas plant, for the same effort, there is required an expenditure of 525 heat units. It ought perhaps to be explained that the term "radiation," covers the heat lost in ashes as well as the heat lost in cooling and scrubbing the gas. It should be borne in mind, moreover, that, whereas the larger the steam plant the better the performance to be expected, the same does not hold good, or at least to but a limited extent, with gas, the performance of the small plant closely approximating that of the larger. This is due to the fact that there are no condensation losses and the proportion of rejected heat is practically constant in gas engines of all powers.

The theoretically possible heat efficiency of the steam plant cannot exceed 30 per cent with no possibility of approaching this in practice, while the gas engine has already surpassed the theoretically perfect steam engine performance, and its theoretical efficiency is much higher yet, and in view of what has been done in a few years only along this line it is reasonable to expect even better results in the future. The present largest losses are in the cooling and in the exhaust and it is to be expected that improvements will be made at these points. The proposal to utilize the waste gases in providing heat for the ship is along this line, though it does not improve the thermal efficiency of the engine.

A point in connection with the adoption of the gas plant in marine work is the influence on the sizes of propeller shafting and on the question of hull vibration, and the diagram of twisting moments illustrates this very clearly. The steam engine strains are from indicator diagrams from a recent example, and can be said to represent good practice. The cards show a power slightly in excess of the 2,000 H. P. aimed at but were the nearest approach to it available, and although the actual engine is 42-in. stroke, the moments are reduced to the same basis as for the gas engine—40-in. Similarly, the gas engine diagrams exhibit a mean pressure slightly below that necessary to produce 2,000 H. P., but the total difference is not material and the result is strikingly close.

In the ordinary triple or quadruple engine, with cylinders of varying diameter, and with steam and inertia stresses also varying widely the disturbing element, if any exists, acts twice in each revolution, in oppositions, and may be due to either working or inertia stress or both. The difference in steam stresses for instance, in the example used, is shown very clearly—the L. P. maximum strains are really 50 per cent higher than the horsepower while the inertia strain are of necessity also much higher. This may or may not create vibration, depending on the period of the ship, which, again, depends upon her trim and the disposition of weights.

With the four-crank gas engine there are four impulses per revolution, all of exactly equal intensity, and all moving weights are exactly alike, so that if any disturbance should be set up it must act four times in each revolution or twice in each direction, which, considering the revolutions to be the same in each case, would give a frequency far in excess of the period of any normal ship and result in an absence of vibration under all conditions of possible trim.

It is not to be expected but that in the extension of the producer system to marine work many things will be found that may be improved and others require modification, but even as it stands nothing has ever been proposed in the history of engineering which, at one step, offers such immediate and large returns, even in the changing of existing plants, while the results to be expected in new construction come very near fulfilling the description of what has so often been described as "revolutionary."

DEARBORN DRUG AND CHEMICAL WORKS.

The Dearborn Drug & Chemical Works, whose manufacturing plant and general offices are located in Chicago, have recently completed a very fine new factory property, on Thirty-fifth street near Morgan. The walls of the building are of brick, and the balance of reinforced concrete, with barns of the same construction. This new plant gives the company about eight times the floor space which their old quarters afforded, and has been fitted with an up-to-date steam plant and the most improved machinery for milling, grinding, boiling and mixing the preparations that this company makes a specialty of manufacturing for purifying different classes of boiler feed waters. These preparations, which are known throughout the commercial world as Dearborn compounds, are used most extensively by all classes of commercial enterprises, for preserving steam boilers, keeping them free from scale, corrosion, pitting and foaming. The careful use of scientifically prepared water treatment is a great factor in the economical operation of any steam plant.

Many of the large steamship companies operating on the great lakes have long since found the necessity of employing Dearborn preparations in the boilers of their lake vessels to overcome the difficulties experienced in marine practice, preserve the boilers and get the greatest economy of operation.

The Dearborn company is glad to receive gallon samples of water for analysis, and to submit proposition for treating same. The eastern offices of this company are located at 299 Broadway, New York city, and they have branches in practically all of the large cities in the United States. Their laboratories are located in the Postal Telegraph building, Chicago, where samples of water should be sent.

The Erie canal was opened to navigation on Sept. 16, having been closed since July 30 owing to the break at Syracuse. This is the longest time that the canal has been out of commission in its history and has meant the loss of many thousands of dollars to canal boat owners.

LAKE SHIP YARD METHODS OF STEEL SHIP CONSTRUCTION

BY ROBERT CURR.

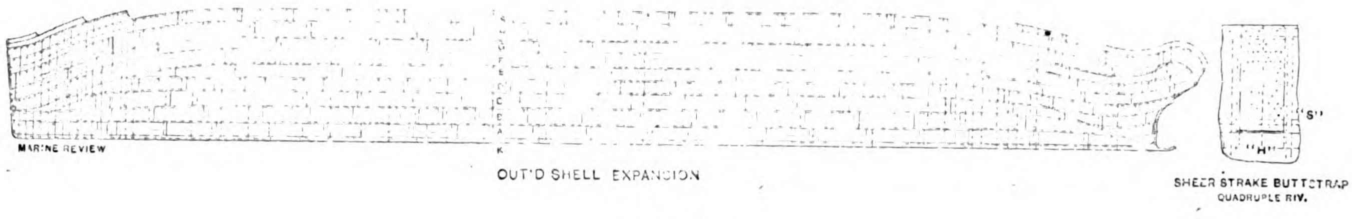


FIG. 13.

Fig. 13 shows the expansion plan. By reference to the midship section it will be seen that the shell plating strakes are all lettered alphabetically from the keel and numbered from the fore end similar to the rest of the material on the vessel.

This plan shows all the girders, longitudinals and decks which are connected to the shell plating. From frame No. 58 to No. 136 the vessel is the same width so that a great number of plates in the bottom are the same size and can be laid off with one mold, but I understand that this firm uses strips for marking all the shell plating on the vessel.

Level lines are used on the plates about the center of same and the frame strips for the rivet holes connecting frames to plating are applied to same. These strips give the width of the plates and location of all longitudinals which are marked upon the strips. In the bottom one strip serves the purpose of marking all the frame holes on the plate because of the plate being square. On the side of the vessel where sheer has to be considered a number of pieces to mark the frame holes are necessary.

Strips for the plate laps are made in one length, changes being made in the spaces where the butt laps are located, seeing the butt laps are less in width than three spaces of rivet holes. The molds used for laying off the shell plates are seam, frame, butt lap and girder molds and these molds are so arranged that there is very little chance of error in marking the plate.

The level line is put on and the frame heels squared from same. The frame mold is applied to these lines, marking all the holes for the frame rivets in the width of the plate. The lap holes serve the purpose as a guide for applying the seam mold.

The seam mold is universal so that it can be turned over to suit either an inside or outside plate. The longitudinal rivet holes are marked with a single space mold, the holes in frame being a guide in detecting an error in applying this mold.

The shell plating is all laid off in this way with the exception of two plates on each strake at the ends.

They are improving on this work all the time and it would be necessary to be on the ground always to give the men credit for their intelligence in doing this work. The time is not far distant when they will put on every shell plate from molds laid out in the mold loft.

Fig. 14 shows the steel deck houses which are all completed from molds made in the mold loft. Molds are made for one side of the vessel and two plates marked from same so that all the steel for the houses is marked, punched and countersunk ready for

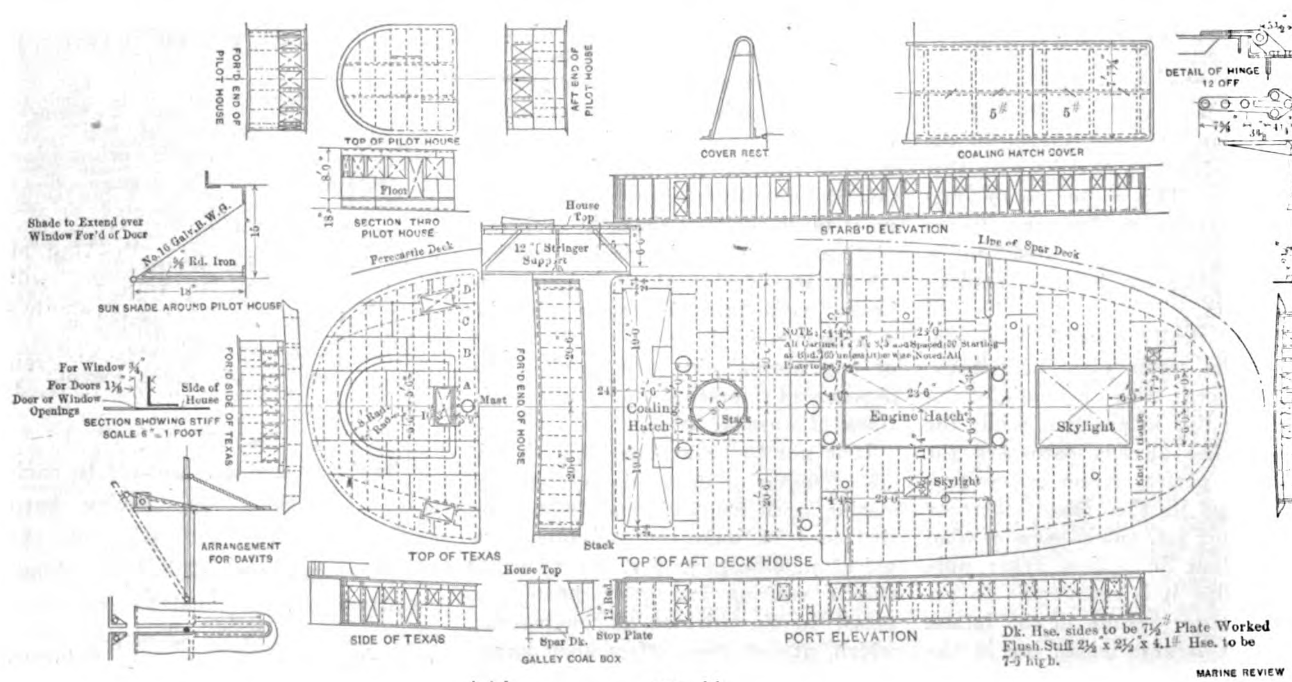


FIG. 14.

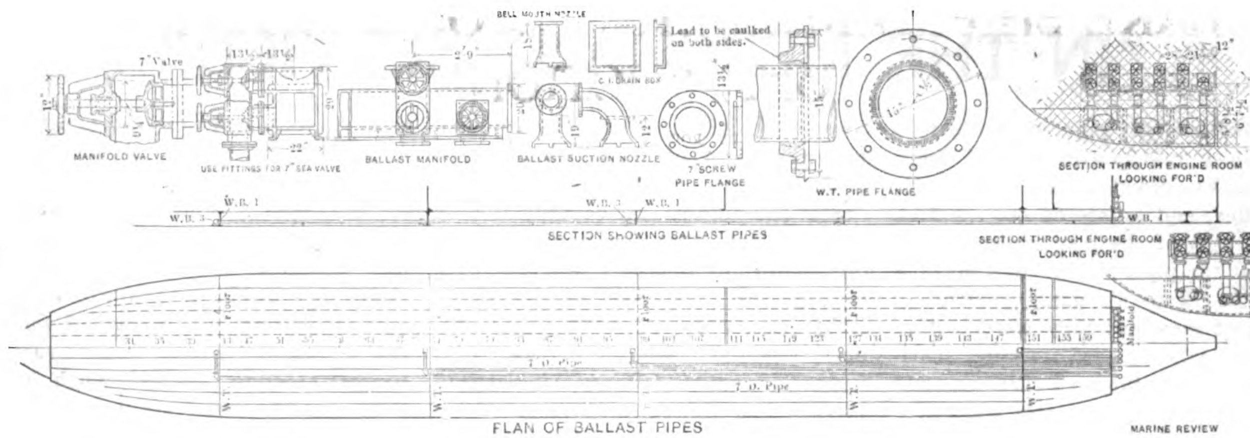


FIG. 15.

erecting when the decks are finished ready to receive same.

Fig. 15 shows the arrangement of the ballast piping as well as the details for same.

This pumping machine, Fig. 16, differs from all others in this respect: that the water from each compartment is handled by separate pump with the old pumps.

The time consumed in pumping out the water ballast is largely done after the water goes down to the top of the deep floors, as the water will not run through the limbers fast enough to supply the capacity of the pump, and if one compartment goes dry, it breaks the vacuum of the suction, and prevents the pump from working.

In this system if one pump is getting water, it primes all of the other pumps automatically and dries out the compartments without any attention on the part of the engineer, and does it in less than one-fourth of the time occupied by any other system.

The engineers operating these pumps are very much elated over the performance, as it saves them a great amount of work. This, itself, is the best evidence that the right thing has been done in adopting this system.

It is the general opinion of engineers, who have looked into this matter, that the pumps on these general lines have got to be adopted to remove the water ballast in a short space of time.

Steamers Sierra, Chas. Hubbard and Smith Thompson have this system and The Great Lakes Engineering Works will put it into two new vessels which they are now building.

The following is the details of work done by the patent ballast pump system on the steamer Charles Hubbard, April 23, 1907:

BALLAST PUMPS.

Has for handling water ballast eight (8) power pumps of the trunk pattern, 16" diameter, 12" stroke, single acting. Capacity, 8.7 gallons per stroke. One (1) duplex pump 8" x 14" x 12". Capacity, 16 gallons per stroke.

In pumping out the tanks the seacock was closed and all the valves to the manifold and pumps opened.

The eight power pumps were started, turning 60 strokes per minute, and duplex 50 strokes on tanks Nos. 1, 2, 3 and 4. The pumps were run in this way for one hour, then closed the valves on the manifold so that each power pump took water from the tanks singly, and opened the valve on No. 5 tank and pumped the water out of it while the power pumps were draining Nos. 1, 2, 3 and 4, port and starboard.

Ballast tanks hold 2,530 tons of water.

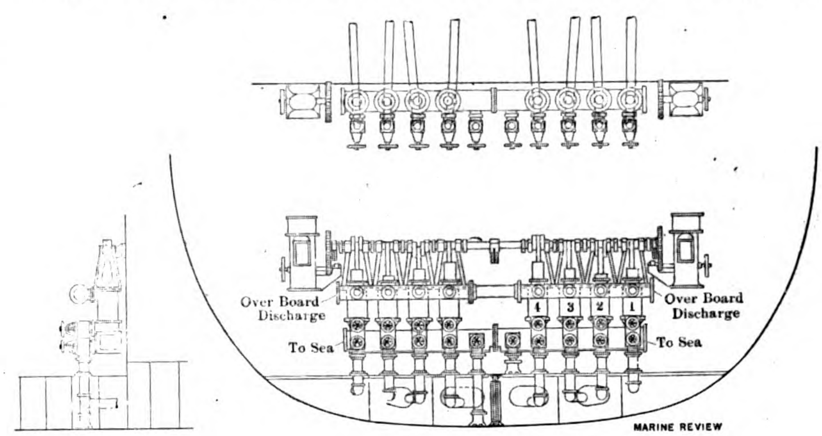


FIG. 16.

Started Pumps	No. 1 tank 450 tons		No. 2 tank 550 tons		No. 3 tank 730 tons		No. 4 tank 580 tons		No. 5 tank 220 tons	
	Port	Star.	Port	Star.	Port	Star.	Port	Star.	Port	Star.
1:40 P. M.	5'-0"	5'-0"	5'-0"	5'- 0"	5'-0"	5'-0"	5'-0"	5'-0"	...	
2:00 P. M.	4'-0"	3'-6"	4'-2"	3'-10"	4'-4"	4'-2"	4'-0"	3'-10"	...	...
2:20 P. M.	2'-11"	2'-6"	2'-10"	3'- 0"	3'-2"	3'-7"	2'-10"	2'-11"	...	...
2:40 P. M.	1'-10"	1'-6"	2'-0"	2'- 0"	2'-7"	2'-9"	2'-0"	2'-3"	...	...
3:00 P. M.	0'-7"	0'-6"	0'-11"	1'- 0"	2'-0"	2'-1"	0'-1"	1'-6"	...	...
3:20 P. M.	0'-3"	0'-0"	0'-3"	0'- 4"	1'-5½"	1'-5"	0'-8"	0'-5"	...	...
3:40 P. M.	0'-0"	0'-0"	0'-2"	0'- 2"	0'-9"	0'-8"	0'-2"	0'-2"	...	...
4:00 P. M.	0'-0"	0'-0"	0'-0"	0'- 0"	0'-2"	0'-3"	0'-0"	0'-0"	...	...

TIME.—2 hours, 20 minutes, taking all the water out.

AROUND THE GREAT LAKES.

The steamer Isaac L. Ellwood of the Pittsburg Steamship Co.'s fleet which was sunk at Bar Point about three weeks ago by the steamer A. G. Brower, was floated and brought to Cleveland, where she will be repaired. The wrecking operations on the steamer were continuously delayed by bad weather. A great portion of her ore cargo had to be lightered and could not be reloaded owing to the great draught of the steamer. Extensive repairs will be required and the steamer will probably be in dry dock for some time. The anchor of the Brower tore a large hole in her side at the turn of her bilge. The lightered ore will probably be brought down by another vessel of the Pittsburg fleet.

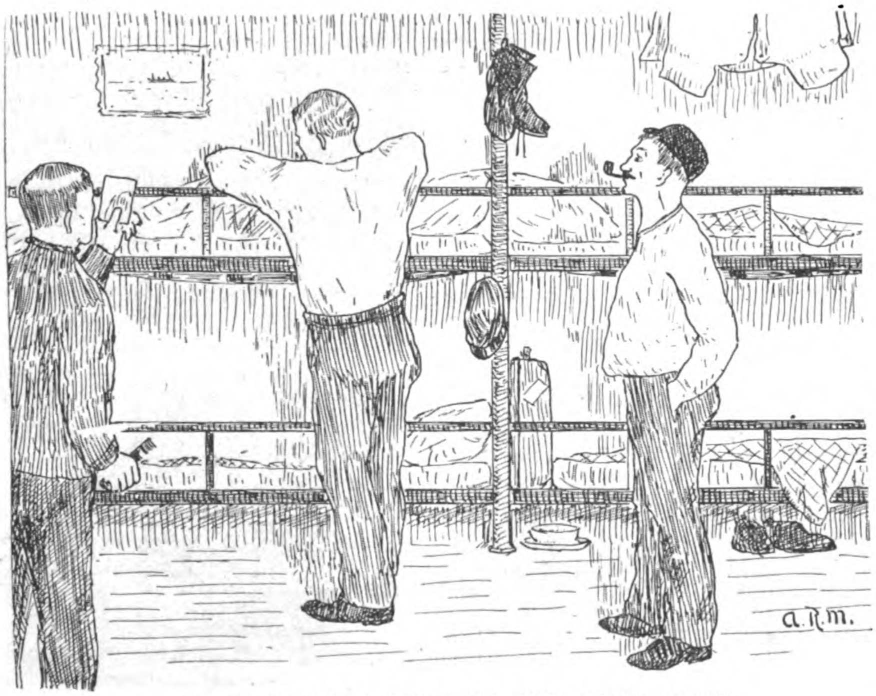
The steamer Mariska, which ran aground at Stag Island, was released, and after reloading her lightered cargo left for Lake Erie apparently uninjured.

"IN THE MERCHANT SERVICE"

The boiler-room gang of the 12 to 4 watch had reluctantly crawled from their bunks, growled over their rolls and coffee, and sauntered out on deck for a breath of the cool night air and a pull at the pipe. There was nothing about the 12 to 4's gang particularly worthy of mention; they were just of the usual callous, hard-working, snarling, bantering type of fireman and coal-passer found the world o'er; generous to a fault, with, perhaps, a trifle stronger desire for the flowing bowl than the average mortal is blessed or unblessed with.

As usual, at midnight, the decks were free of passengers, and save for a small group amidships, were practically deserted. A passenger, an invalid on his way home, had died during the day, and, at the request of his widow, his interment was taking place in the quiet hours of the night. The usual preliminaries had taken place, the service held in the saloon, and the carpenter was preparing to close the casket, when it was found that a pillow under the head of the deceased prevented the cover from being nailed down. Accordingly, the pillow was removed.

The loitering firemen had drawn gradually closer to the little group, their idle curiosity getting the better of their discretion, and running the chance of a sharp order to keep forward on their section of the deck. Seemingly, idle curiosity alone hadn't been the object of one man's close approach, he had witnessed the discarding of the pillow. Incidentally it may be mentioned that the fireman desirous of owning a pillow has to supply that luxury. The sight of the pillow lying temporarily forgotten, on the deck, was too much for the man who had so recently left a comfortless bunk. The doctor glanced over his shoulder in time to see the man and pillow disappearing along the deck.



HE SEARCHED THE BUNKS FOR THE STOLEN PILLOW.

About 1 a. m. our fires had been cleaned and set away. The ash winches were humming, also the fans, and the men were settling down on their steady round. I had overheard some of the watch discussing the pillow incident, and, now, that the strain due to the excitement of fire-cleaning was easing down, thought I would investigate. Not that I was anxious to see the pillow returned; I was merely curious to know this unique culprit.

Beckoning the leading fireman, a strapping big German who ruled the fo'castle with an iron hand and a limited vocabulary of the English language, I asked him what he knew of the pillow incident. He appeared to be annoyed at the idea of the fireman daring to take a saloon pillow down in the fo'castle, and said he'd see what he could do in the matter. It turned out that he later searched all the bunks for the stolen pillow without success, and swore all sorts of vengeance if it wasn't placed in his hands immediately.

During the afternoon watch I again broached the subject. The big German spluttered and swore as he confessed his inability to locate the pillow, promising me he would find it in the near future. In fact, he seemed to be exerting himself much more than usual to assist me in my search, and I thought the matter too trifling for further inquiry.

"Never mind, Schmitt," I said soothingly, "don't trouble any more about it. I dont' want the pillow."

"Himmel," he exclaimed, "it iss voor mysselluf I loog voor dot pillar." Then noticing my look of surprise and amusement, he added in explanation, "It will pe ein goot one, hey?"

The way of the transgressor is sometimes hard to beat.

It wanted but a few minutes of sailing time. The longshoremen stood around the last remaining gangway, ready to swing it clear on the signal. Down below the men were coaxing their fires into life, and generally making preparations for the start down the river. The last muster of the engine department's crew had shown three men of the Second's watch still ashore, a condition of things which worried the Second not a little. They were three of his 'good' men.

The average marine engineer would have little trouble explaining what constitutes in his eyes a 'good' man, but the individual not versed in the component parts of the ship-fireman's make-up would have some little difficulty understanding the explanation. There is the type of fireman who is a quick, steady worker at sea, always willing to help around when the fires are being cleaned. He may be an undesirable citizen in port, shiftless and troublesome, but he is a 'good' man. There is the type who is handy on overhauling work in port, willing and dependable, yet but a passable man on the fires. He, also, is a 'good' man. Lastly, we have the man who never misses his passage, works doggedly at any old job he may be put to, jogs along at his fires at sea, jogs along painting bilges in port, neither happy nor miserable, another 'good' man.

Suddenly the missing men appeared, loaded to the gun'le, pushed their way

through the throng on the dock, ambled up the gangway and stood unsteadily on the deck. The second was sent for, and, though inwardly relieved to know that the men were not to be left derelict on a foreign shore, frowned severely upon them. "Get for'ard to the fo'castle," he snarled, "I'll want to see the three of you when you sober up."

As the men started forward along the deck one of them turned to the second, and, pulling a watch and fifteen dollars from his pocket, held them out toward him.

"D'ye mind lookin' after this, mister," he said thickly, "till we get to N' York?"

On hearing his mate's request, one of the others staggered back to his side and gazed with bulging eyes at the money. He was the hardest of hard cases, and the second knew what was troubling him. "What's the matter, Murphy?" he asked sharply.

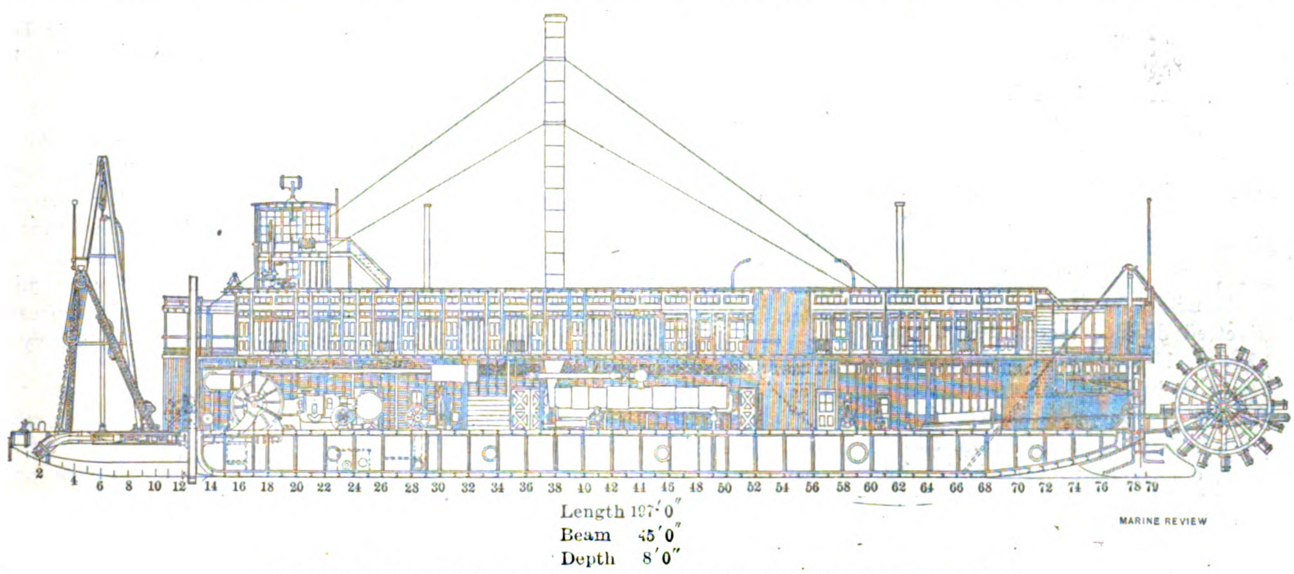
"Matt'r," whined Murphy, looking reproachfully at the owner of the money, "he's a fine shipmate fer a man to be ashore wit', fifteen bones in his clo'es an' us comin' aboard the ship fer good. T'ink of it—fifteen dollars."

He turned on his heel and wabbled his way after the other two, and as he wabbled he muttered "Fifteen dollars—t'ink of it!"

THE "STAND-BY" MAN.

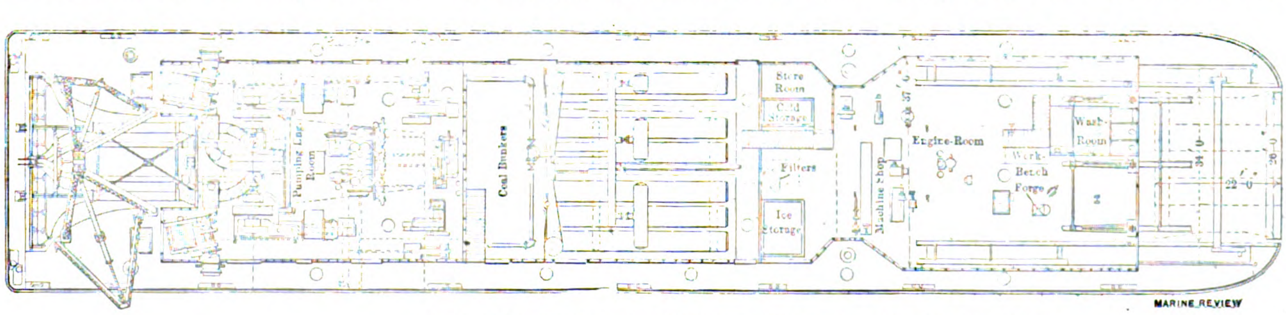
SUCTION DREDGES FOR MISSISSIPPI RIVER

The Dubuque Boat & Boiler Works is building at its yards in Dubuque, Ia., two hydraulic dredges for the government engineers' department at St. Louis. One is to be delivered this fall and the other next spring. These dredges will be self-propelling; with stern-wheel tow-boat machinery, and of the following dimensions: Length between perpendiculars, 197 ft. 0 ins.; beam, molded, 45 ft. 0 ins.; depth, molded, at sides, 7 ft. 6 ins.; depth, molded, at centre-line, 8 ft. 0 ins.; length of suction well, 32 ft. 6 ins.; width of well, forward end, 31 ft. 0 ins.; width of well, after end, 16 ft. 0 ins. The hull will be of steel, without overhanging guards, and with twin bows connected at their forward ends by a bridge or girder. The sand-pump suction-head will be operated in the well or opening between the bows, from a hoisting frame spanning the well. The hull will be framed transversely and stiffened by five transverse and four longitudinal bulkheads, and by intermediate longitudinal rows of stanchions and lattice trusses.

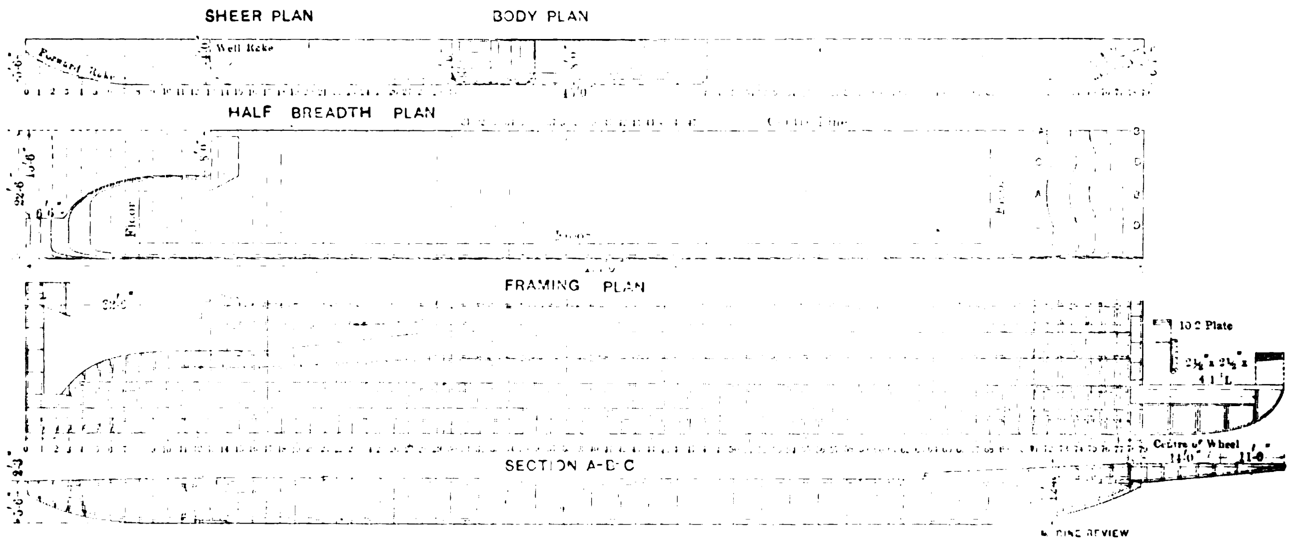


LONGITUDINAL SECTION OF HYDRAULIC DREDGES FOR THE MISSISSIPPI RIVER.

The machinery installation will consist of twin propelling engines coupled at right angles to a stern-wheel shaft, each to have a single cylinder, 24-in. inside diameter by 8-ft. stroke of the usual Mississippi river type, with balanced puppet valves, arranged for working full stroke, and provided with adjustable cut-off. Each pitman will be 32 ft. in length between centers of wrist-pins, built in the usual manner, with a total depth at the middle of length of 31 ins. over the strap-bolt heads. The piston rods will be 6½ in. diameter, the wheel shaft being solid, with the diameter of the in-



MAIN DECK PLAN OF SUCTION DREDGES FOR MISSISSIPPI RIVER.



FRAMING PLAN HYDRAULIC DREDGE FOR MISSISSIPPI RIVER.

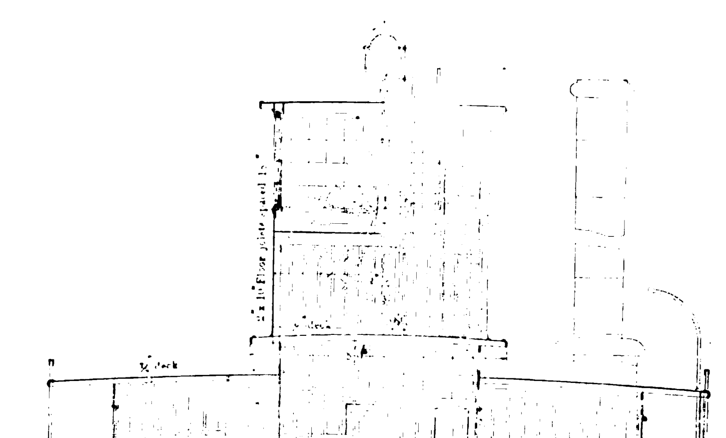
scribed circle 14 ins. at the journals and 15 ins. at the middle. On each crank the hubs will be 28-in. diameter by 10½ in. long for the main journal, and 18-in. diameter by 9-in. long for the crank-pin. A steam reversing engine will be fitted.

There will be six boilers arranged in three batteries of one, two and three boilers respectively. Each boiler will be of the Mississippi river type, 44 in. inside diameter, 30 ft. long, and with five rivetted flues, 3 upper, 10-in., and two lower 11-in., outside diameters. They will be built for a working pressure of 170 lbs. per square inch. Each battery will have a steam drum, 30-in. diameter, connected to each boiler by a leg 12-in. diameter. The three steam-drums will each be connected to a cross steam-main or header, 16-in. diameter, by a 10-in. pipe fitted with a 10-in. gate-valve with by-pass. There will be two muddrums, each 16-in. diameter, connected with each boiler by a leg, 8-in. diameter, and the boilers in each battery will be connected by chock-pipes 6-in. diameter, about 2 ft. from the after end.

The pumping machinery will consist of one main boiler feed pump, walking beam type, with two hot and two cold-water plungers, of ample dimensions to supply the boilers when the pump is running at a rate not exceeding 17 revolutions per minute. The steam cylinder will be equivalent to 10-in. diameter by 24-in. stroke. There will be one auxiliary feed and general service pump, with steam cylinder 9-in. diameter, water cylinders 5-in. diameter, by 10-in. stroke. Beneath the after end of the single-ended boiler will be placed a duplex donkey pump, a vertical coil heater being connected to the pump and boiler. There will also be a filter pump and the usual hand deck-pump.

The electric light plant will consist of one direct-connected engine and dynamo, two hundred incandescent lamps, four arc lights, and a search light. The engine will be driven under a reduced pressure of 80 lbs., will be horizontal, automatically governed to run at from 300 to 350 revolutions per minute. The dynamo will be direct-driven, 6 pole, 110 volts, of "General Electric" or equal make, in capacity not less than 25 K. W. at 300 revolutions per minute. There will be six separate circuits, one for the arc lights, one for the incandescent lamps on the main deck, one for the hold, and two for the boiler deck, pilot house and signal lamps.

The main pumping engine for the dredging machinery will be two in number, horizontal, tandem-compound with a 24-in. stroke, each engine to develop a total of 500 H. P. when making 150 revolutions per minute with steam at 150 lbs. initial pressure. They will be designed for heavy and



HYDRAULIC DREDGE FOR MISSISSIPPI RIVER.

continuous service. Metallic packing will be fitted to all piston and valve rods. The condenser will be of surface type, of cast iron, and, as the circulating water may be as high as 85 F. and will hold a considerable amount of mud in suspension, the water supply will require to be more abundant and the tubes of larger diameter than usual. The usual air and centrifugal circulating pumps will be installed.

The dredging pump will be centrifugal, 32-in. diameter of discharge, of double-suction, shrouded runner type, lined throughout with removable liners, the pump-casing to be of cast iron in five parts. The discharge of the dredging pump will be overhead to the guard of the dredge, and will be directed at will to either side by a horizontal elbow. A priming valve and continuing pipe line to the guard will be on either side of the dredge, and will be fixed in position, the entire ponton pipe-line being joined to either as desired. The pump engines and dredging pumps will be supplied by the E. H. Abadie Co., St. Louis, Mo., at a total cost of $34,595. The Schoellhorn-Albrecht Machine Co., St. Louis, Mo., will supply four hauling winches at a cost of $6,400. The contract price for the hulls with the pontons and pipe lines was $238,000.

The suction-head to the main dredging pump will consist of two members each 13 ft. 8¾ in. long, connected by the junction boxes for two 10-in. jet-header or pressure pipes, which will extend from the boxes each way completely across the suction-head. The suction-head will be 29 ft. 9½ ins. wide over all and will be arranged for dredging, going ahead or astern. Two steady-bars will support the suction-head in operation, and will work in cast-steel guides on the bow girder of the dredge. There will be five cast-iron sheaves with suitable frames for the hoisting tackle, the fall, of ¾ in. wire rope, to be suitably connected to an auxiliary drum on the main hauling winch. The discharge from the dredge will be directed to the ponton line by a sliding or telescoping pipe, which will consist of sixteen 15-ft. sections, and will be 32 in. in diameter. Flexible joints will be fitted throughout. A derrick will be located near the forward end of the after ponton, and will be so constructed as to handle easily any movable part of the pipe-line connecting the dredge and ponton.

There will be four steam capstans, two for'ard and two aft, each to be double-geared and reversing, with two steam cylinders 7-in. diameter by 8-in. stroke. Two main hauling winches will be placed, one on either side of the boat at the forward end of the deck-house, and will have drums arranged to handle the spud-anchor and suction-head. The steam steering gear will have double cylinders 4½-in. diameter by 7-in., to be fitted with raw-hide gear for noiseless operation. A machine-shop will be located in the forward end of the after engine room.

The forward cabin will be 75 ft. long by 32 ft. wide and will contain a central hall with state, bath, and wash-rooms adjoining. The hall will be divided into office and officers' mess room. The after cabin will be 60 ft. long by 35 ft. wide, its forward end being devoted to kitchen, store-room, etc. There will be the usual cabins, toilets, and accommodation for the crew.

NOTES AND COMMENTS.

At the present day the United States Lighthouse Establishment has in use 1,495 lighthouses and beacon lights, 60 lightships,. 142 gas-lighted buoys, 450 fog signals, 1,813 postlights, 683 unlighted day beacons, 95 whistling buoys, 137 bell buoys, and 5,212 buoys of all other kinds.

A crab was captured recently at Montrose, Scotland, which was marked and liberated off Scarborough, Eng., 23 years ago. The distance in a straight line is over 200 miles, but it is probable that the crustacean tacked considerably on its course.

Ergin is a liquid fuel from Germany. It is obtained from tar by a secret process and is reported to have a heating power of 16,500 British Thermal Units per pound.

Point Reyes Lighthouse, in Southern California, is built upon a higher natural location than any light in the world. The Diamond Shoals Lightship, off Cape Hatteras, where storms and sand banks make the "graveyard of the Atlantic," is said to be the strongest lightship in the world.

The French have invented a torpedo which works its way to the object fired at by a series of curves. On an occasion recently, after a torpedo had been fired off, it did the curve business so successfully that the vessel whence it was fired had the greatest difficulty in getting out of the way to reach a place of safety.

The steam whistle was first used in 1833, and was invented by George Stephenson at the request of the manager of the railway line Stephenson had built. Hitherto the engineer on the locomotive blew a horn, but the result wasn't always satisfactory,

A dock cut from solid rock has been put in operation on Lake Victoria Nyanza, at an altitude of 3,800 ft.

Enlisted men in the navy are to receive $1 extra for each day they serve on a submarine that is submerged. That will please them if they can come to the surface and collect it.—*Chicago News.*

Arbroath is mourning the loss of the Dart, one of the most ancient ships on the east coast of Scotland. She was built at Chepstow in 1826 and wrecked at Holy Island recently, the crew getting ashore all safe.

The British Royal navy has recently developed a flag for the exclusive use of submarine vessels, which bears on one portion a representation of two white mice. These tiny creatures are carried on board the submarine, because they are very sensitive to the presence of noxious gases, and their usefulness in this respect has got them the honor of a place on the submarine bunting.

It is reported that experiments will shortly be conducted at Toulon with a new turbine torpedo of greater speed than any at present in existence, capable of traveling a distance of over 2,000 meters and of carrying a much larger charge of explosive than any torpedo now in use.

The Sailor's Friend, a lifeboat built at a cost of $15,000, subscribed for by the residents and visitors, has been launched at Frinton-on-Sea, England. A bottle of water was used in place of the usual wine, all of the lifeboat crew being total abstainers.

In Norway dried seaweed is freely used as fuel.

There are more sharks in the Mediterranean this year than usual. It is supposed that submarine explosions during the late war between Japan and Russia have driven these fish to seek more peaceful homes.

In the Fiords of Norway the clearness of the water is wonderful. Objects the size of a small coin may be seen at a depth of 20 to 30 fathoms.

Mark Twain is credited with saying, after his tour of inspection through the Lusitania, "Well, I guess I'll have to tell Noah all about this when I meet him."

A Danish engineer, H. C. Vogt, of Copenhagen, has invented a propeller for ships that attempts to imitate the action of a fish's tail and combines driving with steering power. Difficulties are being met with in the engine,

however, for with the present form of engines the weight of the driving mechanism is too great to be practicable for steamships.

According to a prominent Belfast surgeon, the cause of seasickness lies in the internal ear. Within the ear are three canals containing a fluid called endolymph. These canals perform the function of a spirit level. The motion of the ship causes a violent and unaccustomed movement in the endolymph, which irritates the delicate nerves terminating in the canals and communicating with the stomach. This irritation first leads to dizziness, then nausea and other symptoms.

This knowledge will not relieve the misery of the sea-sick passenger to any appreciable extent, however.

Attention has again been called to the fact that practically all of the newer vessels of the Turkish navy have never left their moorings in the Golden Horn since they were accepted from their builders. Two fine cruisers, one built by Cramps' of Philadelphia and the other by Armstrong of England, are virtually rotting at their anchorage, which they have never left since their arrival.

It is pointed out by the *London Globe* that the new large-sized submarines of the French navy need cause no misgivings among the naval officers of other countries. Nominally, of course, these vessels with their 450 tons displacement, their 12 knots above water and nine underneath and their capacity to keep the sea for eight days, are formidable, but there are large discounts to be made. For the Opale to keep the sea there must be scarcely a ripple on the surface, there is barely standing room for the men above water, and, in general, these boats are only for service near the coast.

First Lieut. F. A. Levis, executive officer of the United States steamer Tuscarora, has been detached from that vessel and assigned to the position of president of an examining board for the appointments of cadets in the revenue cutter service at Washington, and is then to command the United States steamer Wissahickon at Philadelphia.

The steamer Alaska, of the Anchor line, which ran ashore north of Fox Point, Lake Michigan, on Wednesday of last week, was released and taken to Milwaukee for repairs. The steamer is said to be in bad shape.

ATLANTIC COAST GOSSIP

Office of MARINE REVIEW, 1005 West St. Bldg. New York City.

As a token of their high esteem and regret at his departure, Theodore G. Eger, the retiring general manager of the Clyde line, was presented with a magnificent loving cup on Saturday by the employes of the line. General Freight Agent E. Sindall, who has been associated with Mr. Eger for the past seventeen years, made the presentation.

Mr. Eger was deeply touched, the intention of the employes having been kept secret from him, and, in thanking them for the expression of their regard, spoke of his regret at being compelled to sever connection with the company.

The cup is of solid silver, having on one side a reproduction of the Clyde line steamer Apache, and on the other side is the inscription, which reads as follows:

Presented to
Theodore G. Eger,
Sept. 28, 1907,
as a Token of Sincere Affection
from the Employes
of the
Clyde Steamship Company.

Mr. Eger will be succeeded by H. H. Raymond, general manager of the Mallory line.

Close upon the heels of the news that the Lusitania had covered the total distance of 2,807 knots at an average speed of 22.58 knots per hour, comes the news that she sprinted from Queenstown to Liverpool, a stretch of 228 knots, at a speed of 25 knots per hour, covering the distance in a little over nine hours.

Persons who have been dubiously scanning the columns of the press for the wireless reports of the behavior of the big ship, are now saying: "I told you so," or not, as the news strikes them. It is also reported that the engineers complain of the coal and inefficient firemen, but, as a ship's boilers are not in the best of condition toward the end of the voyage, taking everything into consideration, that 25 knots per hour was good work.

The raising of the American flag over the now practically completed Custom House at Bowling Green, New York, was celebrated on Sept. 26, in the presence of several hundred veterans of the Grand Army and a fair gathering of spectators. Addresses appropriate to the occasion were made by Gen. Geo. B. Loud, Col. Joseph A. Goulden, and R. A. Greenfield, the government superintendent of construction. The flag raising was in no sense an opening of the Custom House, which will not take place before Oct. 15.

There arrived at New York last week the new steamer President Grant, the latest addition to the Hamburg-American line. The President Grant sailed from Hamburg on Sept. 14, with 1,711 passengers, from Boulogne the 15th, and on the 16th from Plymouth. The new steamer is sister ship of the President Lincoln, is 616 ft. long, with a breadth of 68 ft. 6 in., and a gross tonnage of about 18,500. She has twin screws.

Bids opened at the Navy Department for the purchase of the old schoolship Saratoga, lying at League Island Navy Yard, showed only two proposals, one from John H. Gregory, of Perth Amboy, N. J., of $2,000, and the other from Daniel C. O'Connor, of Boston, of $1,251. Inasmuch as the official appraised value of the ship is $4,300, neither of the bids can be accepted, and the vessel must be reappraised and again offered for sale.

North Dakota will be the name of battleship No. 23, one of the new 20,000-ton vessels. The other vessel will be called the Delaware. President Roosevelt has decided that as so many naval vessels bear the names of cities in the state of New York it would be unfair to carry out the original plan of naming No. 23 the New York, and changing the cruiser of that name to the Saratoga. The tars on the New York who dreaded the name-changing hoodo will now breathe freely.

The Allan line steamship Bavarian, which was wrecked on the coast of Nova Scotia and floated by the wreckers last autumn, after having been given up for lost, is now lying alongside the wharf at Indian Cove, N. S. Temporary repairs will be made to enable her to go into dry dock.

After considerable trouble, the Bureau of Navigation has granted permission to change the name of the hull of the ill-fated steamboat General Slocum to the Maryland. The hull has been rebuilt and converted into a barge.

SOCIETY OF BELGIAN MARINE ENGINEERS

CERCLE DES MÉCANICIENS DE MARINE BELGE.

P. J. GOETBLOET, PRESIDENT SOCIETY OF BELGIAN MARINE ENGINEERS.

To improve the standing of the Belgian marine engineer, bring him in closer touch with the shipowner, demand competitive examinations for graded certificates from the government, and to work together for the general welfare of the craft, the Society of Belgian Marine Engineers was formed in April, 1905.

In response to the invitations sent out by the organizers to all known marine engineers under the Belgian flag, twenty-five were in attendence at the temporary headquarters of the society at the first meeting. At this meeting Mr. Adriaenssens, now general secretary of the society, spoke at some length on the grievances of the Belgian marine engineer, the difficulties he had to contend with, suggested ways and means of obtaining redress, and urged the formation of an engineers' society to obtain this redress. Several of those present spoke on the advisability of forming such a society, and at the close of the discussion a list of the qualifications for membership was drawn up as follows:

1st. Any certified marine engineer in Belgium.

2nd. Belgians sailing as engineers on foreign ships.

3rd. Belgians having four years' workshop experience, and at least one year of sea experience. Sea experience to be proved by proper discharges.

4th. Belgians holding certificates for higher studies, Maritime Engineers, and certified experts for the classification of shipping Lloyds, Veritas, etc. By a provisional rule in force at the organizing of the society, all engineers having sailed under the Belgian flag were allowed to join till Dec. 31, 1905. Afterwards, only those satisfying foregoing conditions were allowed to become members.

The aims and objects of the Society of Belgian Marine Engineers, drawn up at the first meeting, are,—

1st. To improve the general condition of engineers serving under the Belgian flag.

2nd. To gradually form subsidized schools to facilitate the teaching and preparation of the candidate for examination as qualified engineer.

3rd. To simplify from a theoretical point the program of courses for marine engineers.

4th. To ameliorate the present laws and regulations, etc.

5th. Exemption from military service.

It will be understood that this last item refers to the European system of compulsory military service—conscription. The disadvantages of this service to the seafarer are so apparent that no detailed mention need be made of them. Though subsidized schools exist for deck officers, supported by the government, up to the present no such concession is made for the marine engineer, he being left to obtain the necessary education as best he can. This usually means taking a course of lessons extending over a certain period once or twice a week. The disadvantage of this system lies in the possibility of the student being unable to attend two or three of the lectures in succession, in which case he falls hopelessly behind the others attending the course and usually has to drop out of the running and make a fresh start.

Several other items in the aims of the society are for the express benefit of the families of indigent and deceased members and other benevolent purposes.

In May, 1905, a second meeting was held, the membership meanwhile having increased to thirty-five. At this meeting Mr. H. Adriaenssens, shipowner and one of the originators of the society, not being according to the necessary qualifications entitled to regular membership, was appointed honorary member. This decision was arrived at because of his known ability and the certainty with which all members were persuaded of his sympathy towards the seafaring class as a whole, and as his co-operation would be of much value to the welfare of the society. Mr. P. J. Goetbloet, naval architect and consulting engineer, was approached with a view to offering him the office of president, which he was pleased to accept. It has long been the ambition of Mr. Goetbloet to organize a society of marine engineers, and much has been done by him for the betterment of the condition of the craft. His sympathy with the movement and wide experience made him, also, a valuable addition to the membership. The two vice presidents are Mr. H. Klunder, superintendent engineer, and Mr. J. De Pamo, consulting engineer.

Since the date of its inauguration the society has been gradually increasing in strength, the membership now numbering 280. Apart from the regular business of the society, much time is devoted at the evening meetings to discussions and lectures on matters of technical interest to the engineer. The instruction and preparation of members of the society as

candidates for examination as qualified engineers has been undertaken by Messrs. H. De Laat, consulting engineer, and J. Betz, government engineer, who also take a prominent part in the discussions and at the lectures. Two languages are used in the reports and spoken at the meetings.

H. ADRIAENSSENS, SECRETARY GENERAL SOCIETY OF BELGIAN MARINE ENGINEERS.

Below are a selection at random of the subjects before the meetings during the past year:

Lecture on "Forced Draught", Mr. H. Klunder.

"Russian Oil Wells: the Mauritania," Mr. W. Roschke.

"Artificial Manufacture of Cold Air and Ice," Mr. O. Van Herp.

"Construction of Parsons Turbines," Mr. P. J. Goetbloet.

"Steam Steering Gear, Slide Valves," Mr. Al. Brandt.

"The Chemical Formation, Preparation, Etc., of Cast Iron, Wrought Iron and Steel," Mr. Fraus Van Riel.

"An Ocean Race and Life Below," reading, Mr. Staal.

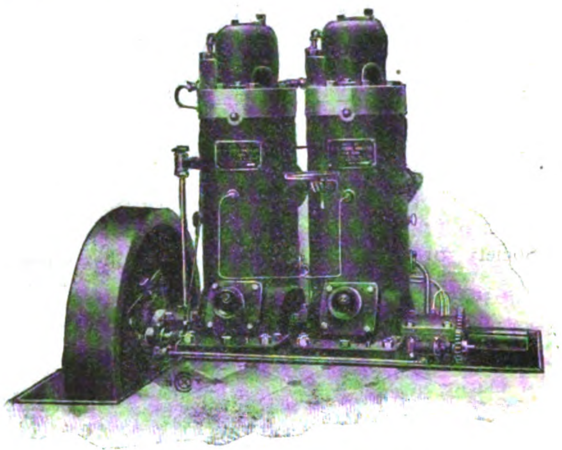
In addition to the above on the program are such subjects as "The Indicator," "Electricity," "Boiler Construction," "Affinity of Metals," "Ship Construction," etc.

The society of Belgian Marine Engineers has among its honorary members several prominent engineers and government officials.

James Kitchen, second mate of the steamer Van Hise, has been promoted to first mate of the steamer Wawatam.

THE KEROSENE OIL ENGINE.

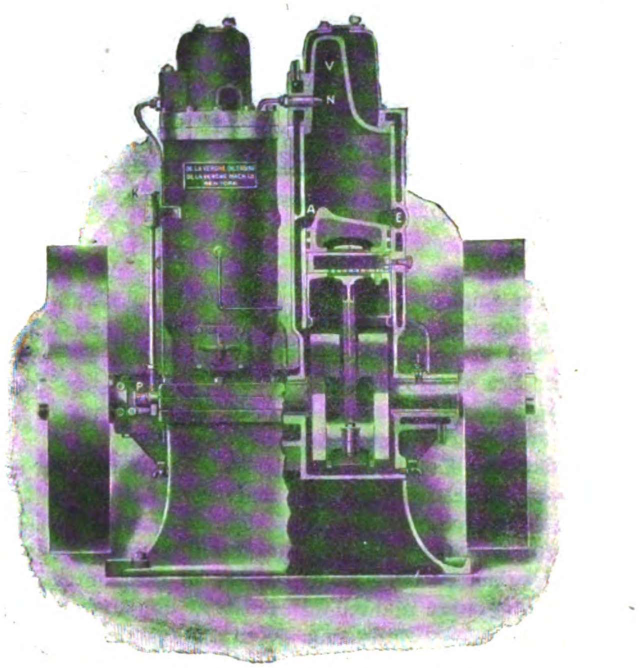
Although the kerosene oil engine is not so well known as the gas or gasoline engine, it is a type of engine that is steadily gaining in favor, due, no doubt, to its absolute safety, simplicity of construction, and low price of operation. In action the latest type of high-speed oil engines are at all times perfectly safe, there being no excessive pressures in the cylinders, and no explosive gases outside of the engine The absence of electric igniter, batteries, and other sparking devices, together with the mixing valve, reduces the amount of care and attention necessary in the gasoline engine to a minimum. The quantity of fuel used is no more than is used by a gasoline engine. The saving when fuel oil is used is approximately the difference between five cents per gallon for oil and twenty cents per gallon for gasoline, depending, of course, on the local price of each.



15 H. P. TWO CYLINDER.

The accompanying illustrations are views of the latest type high-speed vertical oil engines, constructed for use with electric generators, fans, centrifugal pumps, etc. This engine is adaptable for marine use, of 15 B. H. P., and runs on less than two gallons of fuel oil or kerosene per hour. The cylinders are of 7 in. diameter by 7½ in. stroke, with a normal speed of 450 revolutions per minute. The marine type of engine is shown without the iron base.

Fig. 1 shows a twin cylinder engine with one-half in section. Air port A and exhaust port E, at the middle of the cylinder, indicate at once that the engine operates on the two-stroke cycle and is single acting; hence, in a twin cylinder engine, the crank-shaft receives in each revolution two im-



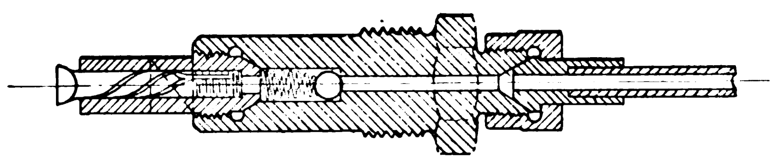
SECTION OF "DE LA VERGNE" TWO-CYCLE ENGINE.

pulses, causing the engine to run much steadier than a four-cycle engine. The cylinder head V is bulb-shaped, made of gun iron, is heated up when started by a kerosene blow lamp, and is kept hot enough by the successive explosions to ignite the combustible mixture.

Pre-ignitions cannot occur in this engine, as, on the upstroke, there is nothing but pure air in the cylinder. This air has entered under slight pressure from the enclosed crank case through port A. As the piston is reversing its motion, but not before, oil is sprayed into vaporizer V by nozzle N. The heat of the walls of the vaporizer and the hot air resulting from the high compression, at once vaporize the oil and burn it rapidly, thus giving the descending piston an impulse. Just before the end of the down-stroke, exhaust port E is uncovered by the piston to let the burnt gases escape to the atmosphere. No exhaust valve is required.

It is, of course, necessary that the oil be forced into the vaporizer suddenly, at the right time, and in quantity to suit the load on the engine. This is accomplished by a small plunger pump which is under the control of an ingenious throttling governor of simple construction, fastened to and revolving with the fly-wheel. In the views we give a section of the steel oil spray nozzle. This is so arranged that it very rarely requires cleaning out, deep grooves being cut helically into the spray pin. The pressure under which the oil is forced through keeps these grooves clean. The nozzle can be cleaned and replaced within a few minutes. The entire nozzle is inserted in a section of the vaporizer which is cooled by circulating water, a steel ball check in the nozzle preventing the explosion from firing back into the oil pipe.

All oil cups have been eliminated, oil being supplied to the cylinders and all bearings, except, of course, the wrist pin, from one forced feed central oiler actuated from the crankshaft. A centrifugal crank-pin oil ring is turned out from the solid of each crank, and with a straight oil hole so disposed that it is always kept clear by the action of centrifugal force.



STEEL SPRAY NOZZLE FOR KEROSENE OIL ENGINE.

A large oil receptacle which holds enough oil for several weeks running lubricates the wrist pin, and can be refilled through the side of the cylinder.

A peculiar and commendable feature is the water cooling device. A small rotary pump driven by spur gear on the shaft circulates the water first through the crank case and bearings, and through the two cylinder heads around the spray nozzle. This cooling prevents the heating up of the air aspirited into the crank case, and keeps down the temperature of the lubricating oil and bearings.

These high-speed kerosene oil engines are built by the De La Vergne Company, of New York, which has been devoting several years to the problem of devising a lighter, faster, and vertical oil engine. The De La Vergne Company build the "Hornsby-Akroyd" a heavy, slow-speed machine operating on the four-stroke cycle, single acting, horizontal, in sizes up to 250 B. H. P.

UNIQUE METALLIC RING PACKING.

The engineer or owner who has experienced the difficulties attending the running of a set of refrigerating machinery fitted with defective rod packing, with the accompanying discomforts of leaking ammonia glands, will appreciate the offer of a thirty-day trial of the Unique metallic ring packing, manufactured by the Unique Engineering Co., of Brooklyn, N. Y., who have placed on the market a packing specially designed for ammonia compressors and high steam pressures.

This packing, which is built in sections, can be fitted to any stuffing box without the necessity of removing the piston rod, is so arranged that lubrication is at all times assured, and is the result of much experimenting in an endeavor to produce a metallic packing which will perfect satisfaction at all times. Its flexibility reduces friction to a minimum and prevents the scoring or cutting of the rods, an asbestos ring increasing its efficiency in this respect.

As a steam-gland packing on high-speed engines or pumps, the packing is peculiarly adapted, being unaffected by changes in pressure or temperature. When in use it requires little or no attention, and is easily inspected or overhauled.

LAKE LAUNCHINGS.

The bulk freighter Edward N. Ohl, building at the Wyandotte yard of the American Ship Building Co. for the Vesta Transit Co. of Cleveland of which W. H. Becker is manager, was launched on Saturday last and was christened by Mrs. J. W. Westcott of Detroit. The Ohl is 440 ft. over all, 420 ft. keel, 54 ft. beam and 28 ft. deep. She will have triple-expansion engines with cylinders 22, 35 and 58 in. diameters by 42 ft. 6 in., stroke, supplied with steam by Scotch boilers, 13 ft. 9 in. by 11 ft. 6 in, equipped with Ellis & Eaves draft and allowed a working pressure of 180 lbs. Her carrying capacity is 7,500 gross tons. Immediately following the launching the steamer was towed to the Orleans street dock of the ship building company to be completed, and it is expected that she will be ready to go into commission on Oct. 20.

The steamer Rochester building for the Western Transit Co. of Buffalo was launched at the Ecorse yard of the Great Lakes Engineering Works on Saturday, and was christened by Miss Sue H. Hoyt, daughter of H. W. Hoyt, vice president of the ship building company. The Rochester is a package freighter and is a duplicate of the steamer Duluth. She is 408 ft. over all, 388 ft. keel, 50 ft. beam and 30 ft. deep. She will have quadruple-expansion engines, 21, 30, 43½ and 63 in. cylinder diameters by 42-in. stroke. Her boilers will be of the Scotch type, 14 ft. 10 in. by 12 ft. It is expected that she will go into commission on Nov. 15.

CAPT JOHN LOWE.

Capt. John Lowe of Cleveland, one of the best known and most successful masters on the great lakes, has given up the command of the steamer Peter A. B. Widener for the balance of the season, owing to ill health. Capt. Lowe has been sailing on the lakes for over fifty years, and has during later years brought out several new steamers. He will be succeeded by Capt. Fred Hoffman, of the steamer James J. Hill. No man is better known or better liked on the lakes than Capt. Lowe and his forced relinquishment of his ship is regretted by all.

The tug Conneaut of the Great Lakes Towing Co.'s fleet, which was rebuilt, is again in commission at Buffalo.

CLEVELAND-CLIFFS CHANGES.

The following changes in masters on boats operated in the office of the Cleveland-Cliffs Iron Co. have been made: Capt. George Trimble who has been sailing the steamer Cadillac thus far this season, has been transferred to the steamer Choctaw, and mate Peter Anderson of the steamer Angeline has been made master of the Cadillac. Capt. W. H. Hoffman has temporarily taken the steamer Presque Isle for a few trips, while Capt. F. A. West of that steamer lays off to hasten the recovery of a broken arm sustained at Marquette while hurrying to aid in putting out a fire on the steamer Portage. Later in the season Capt. Hoffman will bring out a new steamer now building for Detroit parties, in which he is interested.

LONGEVITY OF WOODEN FLEET.

Capt. J. J. H. Brown of Buffalo recently wrote to Capt. A. B. Drake, chief inspector of Inland Lloyds, regarding the Scotia. His reply is interesting as showing the longevity of the wooden fleet:

"Your favor of the 18th, referring to Scotia, built in 1873 and now in A 2 class in the *Register,* and asking if there are any others of her age that class as well, received, and in reply thereto I will say that there are several which can better the Scotia considerably. I give you a memorandum of such as I noticed in hurriedly looking over the *Register.*

Year	Strs.	Schrs.	Barges.	For a 1½ class and year blt.
1854	6	1	1	
1856	—	2	—	
1862	1	—	—	1 Steamer
1863	1	—	2	
1864	—	—	1	
1866	1	3	3	1 Barge
1867	4	6	5	1 Barge
1868	1	—	4	
1869	1	2	2	1 Steamer
1870	1	—	—	
1871	2	1	5	
1872	3	1	7	2 Steamers
1873	4	3	11	1 Steamer

The above are all in A 2 class except the five steamers and two barges in the column at the right.

A. B. DRAKE."

FREIGHT SITUATION.

On Oct. 1, in accordance with agreements made last spring, the wages of wheelsmen and lookouts, firemen, oilers and water tenders, ordinary seamen, porters and second cooks, have been advanced. For the balance of the year second cooks will receive \$37.50 per month, porters \$35, firemen, oilers and water tenders \$65, wheelsmen and lookouts \$65, ordinary seamen \$40.

Heavy weather has lessened the movement of ore and shippers are having difficulty in taking care of contract tonnage. There is therefore very little demand for wild boats in the ore trade. Coal appears to be moving more freely and the grain trade is firm. The rate from Duluth to Buffalo has been marked up to 2¼ cents.

IRON SITUATION.

An adjustment in orderly fashion to the less active business conditions prevailing is being made by the iron and steel industry, and preparations for the closing down of plants for repairs and the restriction of output are numerous. Pig iron remains in a quiet state but prices are holding firm. More active competition by the larger interests for small orders is prevailing and reports of price cutting in finished lines are numerous. The general situation in this respect is somewhat slightly improved, however.

OBITUARIES.

Capt. M. M. Drake, who had been an important figure in great lakes trade for many years, died at the General hospital in Buffalo last week. He was born in Cortland, N. Y., in 1835. He began sailing at the age of sixteen years as a common seaman. In 1861 when the war broke out he was captain of a steamboat but resigned to enlist as a private with the 72d New York volunteers, reaching the rank of first lieutenant during the war. After the war he returned to the lakes, becoming superintendent of repairs of the Union Steamboat Co. In 1871 he was made superintendent of the Union Dry Dock Co., resigning later to become superintendent of the Lackawanna Transportation Co. Capt. Drake was always active in the political life of Buffalo and was appointed mayor of Buffalo when Grover Cleveland resigned that office to become governor of New York.

Capt. Frederick Thomas of Port Huron, master of the steamer Brazil, died suddenly last Friday in the marine hospital at Buffalo after a few days' illness from spinal trouble. Capt. Thomas was only twenty years old and the present season was his first on the lakes.

Louis P. Tuttle, of Bay City, deck hand on the whaleback steamer John Ericsson, fell into the cargo hold of the steamer while she was lying at the Mesabi ore docks at Duluth, and was killed.

HIGHER STANDARDS FOR ENGINEERS.

Wm. Kelly, business agent, M. E. B. A., Cleveland, O.: "We are fighting ignorance, bigotry and selfishness, not only in our own ranks but on the outside so far as is practical. We are trying to keep out of trouble and other difficulties, and are therefore steering clear of them as much as is possible. We are educating our men in the higher standards and are only encouraging those of the higher types, and education is doing wonders along these lines; men are better able to cope with the difficult problems confronting them and are better able to deal with them in a fair and unbiased manner. We have no time for the grumbler, the disturber and the fanatic, and growling we will not tolerate. We want the peace-maker, the man of brains, intellect and prudence."

BLOWING OF STEAM WHISTLES.

Editor MARINE REVIEW:—Our attention has been called to the fact that the unnecessary blowing of steam whistles is receiving considerable attention throughout the country. On Aug. 12, 1907, the following was sent to the masters of this company's fleet:

"On and after this date the steam whistles must not be used for saluting. All salutes will be given by dipping the ensign once."

We believe that this company was one of the first, if not the very first, to instruct its masters to cease unnecessary whistling.

Yours truly,

H. W. THORP,
Gen'l Manager.

The accident reported to have occurred to the barge B. B. Buckhout, owned by Shannon & Garey, Saginaw, Mich., and which was noted in the table of accidents in the Sept. 12 issue of the MARINE REVIEW now appears to have been much less serious than was at first announced. She did not sink at her dock at Alpena but merely put in there to have a diver go down and patch a hole which was stove in her at Blind river. There was not over 20 in. of water in her at any time.

BOILER OF TUG SPEAR.

Bids for furnishing a boiler for the United States tug Spear opened by Lieut. Col. Townsend, government engineer at Cleveland, on Monday of this week, were as follows: Lake Erie Boiler Works, Buffalo, \$5,000; B. Connelly Co., Cleveland, \$5,100; Kingsford Foundry & Machine Works, Oswego, N. Y., \$4,787.55.

ADVERTISERS

The Star indicates alternate insertions, the Dagger once a month.

CLASSIFIED ADVERTISING SERVICE

PROPOSALS.

U. S. Engineer Office, Jones Building, Detroit, Mich., Aug. 26, 1907. Sealed proposals for dredging Section 1, Plan B, Detroit River, will be received here until 3 P. M. October 8, 1907, and then publicly opened. Information furnished on application. Chas. E. L. B. Davis, Col., Engrs.

U. S. Engineer Office, Jones Bldg., Detroit, Mich., August 26, 1907. Sealed proposals for rock and earth excavation, Section 2, Plan B., Detroit River, will be received here until 3 P. M., October 7, 1907, and then publicly opened. Information furnished on application. Chas. E. L. B. Davis, Col., Engrs.

U. S. Engineer Office, Louisville, Ky., Sept. 21, 1907. Sealed proposals for two dump scows will be received here until 12 noon, Standard Central time, Oct. 21, 1907, and then publicly opened. Information furnished on application. H. Burgess, Capt. Engrs.

U. S. Engineer Office, Louisville, Ky., Sept. 21, 1907. Sealed proposals for two steel barges will be received here until 12 noon, Standard Central time, Oct. 21, 1907, and then publicly opened. Information furnished on application. H. Burgess, Capt. Engrs.

U. S. Engineer Office, Louisville, Ky., October 3, 1907. Sealed proposals for steel hull for snagboat will be received here until 12 noon, standard central time, November 4, 1907, and then publicly opened. Information furnished on application. H. Burgess, Capt. Engrs.

COAL HANDLING MACHINE

ONE BROWN RAPID COAL Handling Machine for sale. Now in use at Toledo Docks. This Machine is in very fair shape and is to be replaced by one of larger capacity. Will be glad to furnish any information to interested parties.

C. B. Duffy, P. A.
Hocking Valley Ry.
Columbus, O.

BOILERS FOR SALE

TWO MARINE BOILERS for sale, 15 ft. 10 in. diameter, 10 ft. 5 in. long; 4 corrugated furnaces each. Address the Griscom-Spencer Company, 90 West St., New York City.

TWO SECOND HAND 11 x 12 or 12 x 12 Scotch Boilers Wanted in first class condition. Address X. Y. Z., the MARINE REVIEW, Cleveland, Ohio.

STEAMERS FOR SALE.

THE LIGHTHOUSE STEAMER Haze, 145 ft. long, 27-ft. beam, 9-ft. draught, 500 tons capacity, 300 horse-power engine and boiler, suitable for passenger or freight business, fully equipped. Steam capstan, donkey boiler. Jacob Ullman, 46 Lloyd street, Buffalo, N. Y.

PASSENGER STEAMER GRANDON for sale, composite build 70 ft. long, 16½ ft. beam, compound engine, independent air pump. Boiler is new 1907, allowed 207 lbs. steam. Equipment is very complete. Also one lighter 100 tons capacity, built of oak, three years old. For information address Henry Freyensee, Sandusky, Ohio.

A WOODEN STEAMER OF 3,200 gross tons burthen, for sale; in good condition. Address V. M., the MARINE REVIEW, Cleveland, Ohio.

STEAMER V. SWAIN FOR SALE, coal capacity 1,200 tons. Now lying at Superior, Wisc.

Also Tow Barge Wm. McGregor, coal capacity. 1,400 tons. For particulars, address J. E. Sheehan, 970 Fourth Ave., Detroit, Mich.

VESSEL BROKER.

TALK WITH BRADLEY.—Before buying or selling a boat. I have vessels of most every kind—from 10 tons to 6,000 tons—to sell for owners. Anybody wishing to buy or sell boats should call or write.

Fred A. Bradley,
247 Delaware Ave.,
Buffalo, N. Y.

Bell 'Phone, Tupper 5933.

PUMP FOR SALE

CENTRIFUGAL DREDGE PUMP for sale, No. 10 Van Wie make. Address The Cowing Engineering Co., 426 Citizens Bldg., Cleveland, Ohio.

ENGINE FOR SALE

ONE 7½-INCH — 17-INCH x 10-inch fore and aft Vertical Compound Marine Engine, for sale, Reeves make, at a bargain; in first class condition; used only short time. Would exchange for a smaller one of size 6 inch—12 inch x 8 inch. For particulars apply to Morris Sherman Mfg. Co., Chattanooga, Tenn.

FOR SALE, MISCELLANEOUS.

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